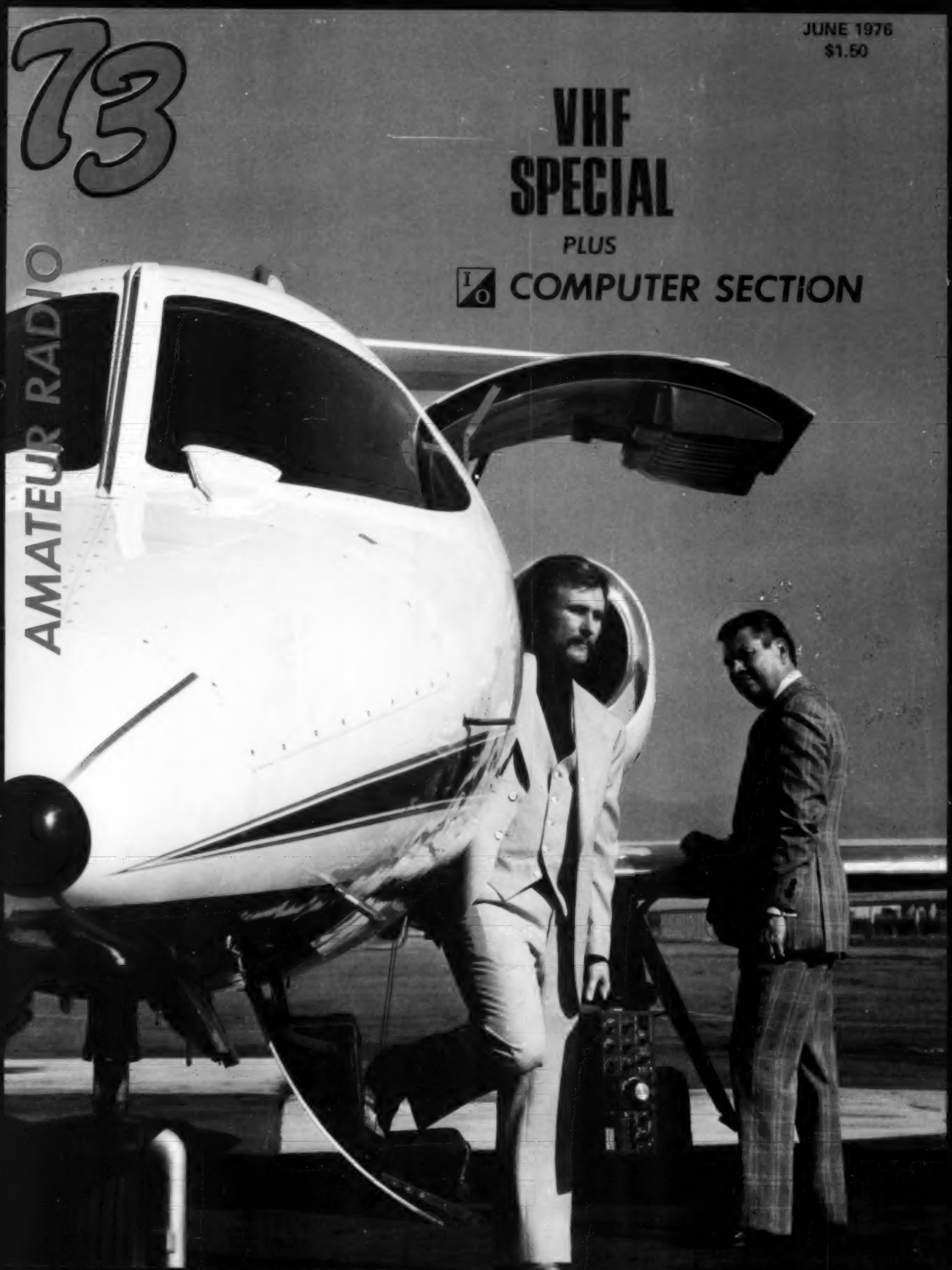
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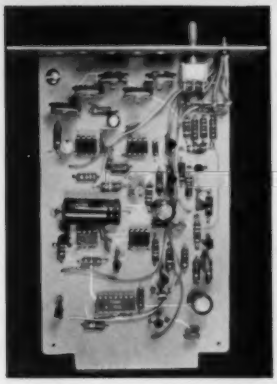

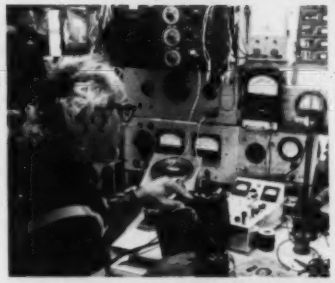

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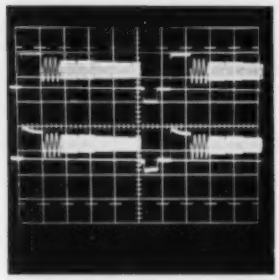

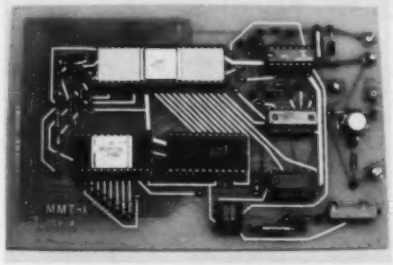

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COVER: The new Kenwood TS-820. Lear jet courtesy of The Great Atlantic and Pacific Aeroplane Company, and Lacy Aviation, Van Nuys, California.

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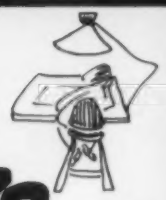

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EDITORIAL BY WAYNE GREEN

PANIC IN NEWINGTON

Well, I almost went out to the Denver ARRL Convention. Pity, I've been wanting to visit Denver for some time ... they have a particularly active ham computer group there. The convention committee called and asked me to be on the program ... fine, I enjoy entertaining and the larger the crowd the better. I love having a chance to talk about the past, the present and the future of our hobby.

But I warned them that they might have a tough fight on their hands getting Newington to let me talk. They turn white when they hear about it and they've kept me off the programs of most conventions for many years. No strain, I was told ... a couple days later came the apologetic call ... sorry, we can't have you on the program.

So I asked why the League is so terrified of me ... are they afraid I'll tell lies or the truth? If it's lies, then they are saying that they feel the members are so stupid or gullible that they will believe me ... if it is truth that frightens them, they have no choice but to try and stifle me. Either way speaks badly for them.

I am assured by our lawyers that I could force the League to permit me to talk, but I feel that something like that will have to come from the members or more courageous convention committees, not from a lawsuit. I am fun to hear, I have done just about everything there is to do in amateur radio, and I tell it like it is with no holds barred ... things that I couldn't put in print ... like why over a dozen firms are not permitted to advertise in *73* as a protection to the readers ... firms which are advertising in other ham magazines ... things like that.

You know, it is a pity ... there are so few entertaining ham speakers available ... I remember the time I was invited out to San Francisco to speak at the ARRL Convention there. After I got there they took me aside and explained that ARRL HQ had put their foot down ... I could not speak, even at a couple of small banquets for special groups. They did manage to sneak me into a RTTY breakfast meeting that ARRL didn't know about. That was a long trip for nothing.

The fact is that such a high percentage of the active amateurs already read *73* that it is almost impossible for me to sell enough subscriptions at a convention to pay my way. Thus I rarely go to a convention unless I am on the program where I will have a chance to talk with a large number of people. At a booth I get a chance to say hello to a couple hundred readers, but no opportunity to talk at any length with anyone ... and certainly no chance to try to explain what is happening in amateur radio today and what will be happening tomorrow ... what the real inside situation is with the FCC ... things like that.

If I'll have a good opportunity to entertain, I'll go to almost any convention ... so if you are interested in knowing what is what ... the inside info ... or have any questions for me ... make it known to convention committees that you want me there ... and to hell with Newington. You want to know what really happened with BYTE? Or with the IRS? I can't print that stuff.

ATLANTA – WAYNE SPEAKS!

At least the latest word is that I will definitely be on the program at Atlanta ... more power to my buddy Chaz Cone, who led the brave expedition to Navassa back in 1972. I had such a great time during my first visit to Atlanta a couple years ago that I am really looking forward to the trip. They know how to make a visitor welcome there. The 1974 hamfest wasn't much, but their 1975 effort was a blast and really made up for the previous try. This year should be even greater, despite my talk.

MAGAZINE LAYOUT

Whilst most readers probably don't give a lot of thought to whether a magazine page is laid out with two columns of type, three, or four, it probably will not come as any great surprise to learn that the few unfortunate people who put out ham magazines worry about that sort of thing all out of proportion to its importance.

For instance, when I got the idea for BYTE magazine and decided that it really had to be in the 8½" x 11" format in order to accommodate the ads being run in other computer magazines, I started looking over every magazine I could find to see what layout I liked the best. Three column was okay, but hell, everyone uses that and I am not all that well known for following the crowd. Two column is just too damned hard to read. The easiest type to read is the narrow columns used by most newspapers ... a little under two inches wide. Anyone with speed reading experience can really whiz down these narrow columns ... particularly on a second reading.

If you're not into speed reading, it wouldn't hurt to try it. Many schools provide low cost night classes which will teach you the techniques involved in a few sessions. Even up here in Peterborough the local high school gives speed reading classes for adults.

Once you've read through a technical article carefully you should normally remember about 20% of it pretty well. By doing a fast scan of the article afterward you can increase comprehension and memory to a much higher percentage. And, like RAM memory chips, an occasional refresh flash will keep the material available for use. There are some mental scanning techniques which I have never seen written up anywhere, but which will allow you to keep virtually every detail of hundreds of books right fresh in your mind ... I'll have to write that up one of these days ... fantastic for preparing for exams ... or just for keeping enormous amounts of data fresh in your mind.

At any rate, I thought I'd try the narrower columns and run four to the page. In addition to being a great deal easier to read and scan, this would also permit great flexibility in the laying out of pages. Schematics could be one, two, three or four columns wide ... photographs could be made almost any size ... etc. Of course this flexibility also meant that the laying out of the articles would be a lot more difficult. The old two column layouts left little room for originality or imagination ... and thus were a snap to do.

After some fifteen years of the old two column pasteups, I met more than a little resistance over my four column layouts. I liked them. The first three issues of BYTE used this format. Then, against my better judgment, I let myself be overruled and a compromise two and a half column layout was tried. The first large issue of *73* came out with this layout. I hated it. Few readers noticed the great areas of wasted white space on many of the pages, but my many generations of Yankee blood curdled at the blank spaces ... spaces which should have type in them. If it weren't for my eyesight failing so rapidly, I'm sure I would print the whole magazine

Continued on page 24

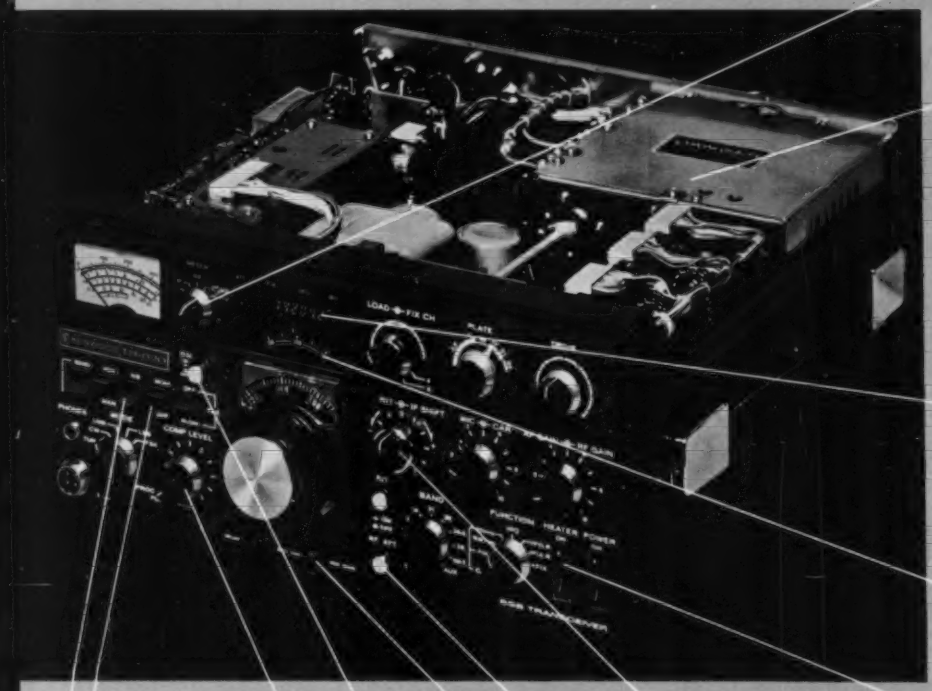
KENWOOD'S TS-820

the Pacesetter

LIMITED QUANTITIES AVAILABLE IN JULY

Kenwood's well deserved reputation for fine craftsmanship and superb performance has never been more evident than in the TS-820. As a result of a host of innovative features being brought together, the 820 offers a degree of versatility, performance and pleasure second to none.

The Kenwood TS-820 is destined to be the world's new standard of excellence in amateur radio for years to come . . . a true "Pacesetter".



Features

PLL • The TS-820 employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now, PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

FULL METERING • During receive, an easy to read meter functions as an S-meter. The same meter displays ALC level, plate current, RF output, and plate voltage during transmit. Includes COMP setting for adjusting the compression level of the built-in speech processor.

FINAL AMPLIFIER • The TS-820 is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity. The input power of the TS-820 is conservatively rated at 160 W DC, 200 W PEP. Tubes run cool with the aid of a noiseless fan (standard) mounted on the rear panel. The above tube and power combination minimizes the possibilities of TVI and helps to maintain the Kenwood reputation for excellent audio quality.

DIGITAL READOUT DG-1 • (optional) A digital counter display can be employed as an integral part of the VFO readout system. Counter mixes the carrier, VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

DRS DIAL • Includes the same satin-smooth planetary drive found on other fine Kenwood models plus special, high-precision gears to add a new "monoscale" feature for easier frequency readout. LSB, USB, and CW operating frequencies can be accurately read from the same pointer.

HEATER SWITCH • The filaments of the three vacuum tubes may be turned off during periods of "receive only".

CW AUDIO CHARACTERISTICS • During CW reception, a special filter is used to alter the audio frequency response to provide a more comfortable, easy to copy tone.

NOISE BLANKER • The TS-820 uses an efficient noise blanker circuit, another Kenwood exclusive. A special crystal filter assures unsurpassed efficiency in eliminating unwanted pulse noises.

RF MONITOR • Built-in monitor circuit allows you to hear your own voice by sampling the RF signal. Especially useful for adjusting the RF Processor.

HIGH STABILITY VFO • The VFO, heart of any SSB transceiver, is an exclusive Kenwood design using FET technology.

DIGITAL HOLD • A single pushbutton switch offers the operator unprecedented versatility. The digital hold circuit will lock the counter and display at any frequency, but will allow the VFO to tune normally. Ever wanted to return to a certain spot on the band and forgotten the frequency? That won't happen again with the new digital hold feature on the Kenwood TS-820.

SPEECH PROCESSOR • An HF circuit provides quick time constant compression using a true RF compressor as opposed to an IF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. Enables the operator to eliminate unwanted signals by moving them out of the passband of the receiver. This feature alone makes the TS-820 the pacesetter that it is.

RF ATTENUATOR • Easy, one touch activation of the attenuator supplies 20 dB of padding on receive.

VOX • A voice-activated microphone circuit is built into the TS-820 with VOX GAIN, ANTIVOX, and VOX DELAY controls placed on the front panel for convenient adjustment any time.

Other features include:
- Built-in 25 kHz calibrator*
- Built-in speaker*
- CW Sidetone and semi-break in*
- Rear panel terminals for linear amplifier, IF OUT, RTTY, and XVTR.
- Handy phone patch IN and OUT terminals*

*Also available, the VFO-820 . . . the perfect companion to the TS-820.

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KENWOOD
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visiting views from around the world

"God Bless You All"

In the hours following February's earthquake in Guatemala, the only news reaching the outside world of the catastrophe emanated from a small group of amateur radio operators in the stricken country and in the United States.

The communications chaos was such that it fell upon these hams to inform the Red Cross, the State Department, the Guatemalan embassy here and other organizations of the extent of the disaster and the type of assistance needed.

One of the first on the air was Clyde Stanford, who works for the Central American Mission in Guatemala City. He roamed the city in his short wave equipped car, giving vivid accounts to the outside world of the devastation.

Monitoring Stanford in Miami was the amateur radio listening post of the Dade County Chapter of the American Red Cross, which immediately relayed his reports to Red Cross national headquarters here.

The damage figures given by Stanford over TG9LW (his station's call letters) and by Don Fiester, another amateur in Guatemala City, over TG9DF, were at first thought to be highly exaggerated.

Later information, however, proved they were understated if anything.

In the days since the earthquake, the amateur operators have turned their attention to obtaining health and welfare inquiries from people in this and other countries worried over the fate of relatives and friends in Guatemala.

Among the ham operators here who have been on the air almost continually since the disaster is Lewis Bloch of suburban Fairfax Station, Va. For a brief period following the quake, he was a main source of information for the Guatemalan embassy on the events taking place in the homeland.

Now Bloch, who is a publisher working out of his home, is handling welfare messages by the dozens. Typical is one for the American Red Cross.

The organization was contacted by John S. Whiting of Deerfield, Ill., whose son was working at the Spanish School in the city of Antigua when the disaster struck. Concerned that he had heard nothing about the boy's fate, he called the Red Cross here.

Within an hour, Bloch was on the air, asking amateurs in Guatemala if they could provide some information about the younger Whiting.

Bloch is an old hand in disaster situations. When an earthquake struck in Nicaragua a few years back, he recalls that he was on the air for days relaying reports and requests for assistance.

Another amateur, Joseph W. Miller, Bloch's next door neighbor, has handled over 200 messages since the earthquake, working as a volunteer for the Fairfax County Chapter of the Red Cross. As Bloch puts it, "Miller has been the workhorse on the operation."

Bud Fink, chief of radio communications for the American Red Cross, has nothing but praise for the ham operators. Through an agreement the organization has with the ARRL, the operators funnel vital information to the organization not only on foreign but domestic disasters as well.

The American National Red Cross

* * * * *

The cold statistics of death and destruction from last week's earthquake in Guatemala caused days of anguish to thousands of relatives in the United States, but ham radio stations in both countries have begun to bring relief to some, grievous certainty to others.

At the Hall of Science in Flushing Meadow, Queens, volunteer operators yesterday manned Amateur Radio Station WB2JSM to relay scores of inquiries from anxious relatives in the Metropolitan area and incoming responses from fellow hams in Guatemala and the Red Cross station in Miami.

"Some of the news, fortunately even most of it, has been good," said Robert C. Reiley, call letters WB2FHN, the executive director of the Hall of Science and a radio buff since 1939. "But there's been bad news as well."

GOOD NEWS

Mr. Reiley said that the station he was manning was in touch with about a half dozen English-speaking hams in Guatemala, including a young Californian known as Joanne K6GFW, who operated with a portable radio transmitter and emergency generator from her home just outside Guatemala City.

Among the good news received from Joanne, Mr. Reiley reported, was a message for a family in Elmhurst, Queens, whose daughter, a registered nurse married to a Dutch United Nations official, had not been heard from. Her father, Earl Cosgrove, said last night that the young couple, Ruud and Marie Anne Ooye, were in Guatemala last Wednesday when the earthquake struck.

John Gorman WB2ROF sends traffic to Guatemala City, while anxious relatives wait for reply.

Martin Schwartz W2EPZ, a 44 year veteran of ham radio, prepares traffic to be sent to Guatemala.

Photos courtesy of Rick Moran WA2BBG, Photo Associates, New York.

"Even the U.N. couldn't get them," Mr. Reiley said, sitting at his bank of radio equipment with two other volunteers, Conrad Eiselen WB2FGB and Dan Algeri WA2MXI. "But we got through all right."

NUMBER HELPS

He said Joanne had been able to find out for the Cosgroves that their daughter was well and working in an emergency hospital in the Guatemalan town of San Lucas.

Mr. Reiley said most of the nearly 200 inquiries relayed from Flushing Meadow Park up to last night were from Guatemalan residents in this area. He said the station, the most powerful of its kind in the city, would be operating again today from 10 am to 10 pm and could be reached by calling 699-9400.

"If we have a telephone number to call down there, that helps," he said. Inquiries without telephone numbers would be routed via Miami and Pan American World Airways, which volunteered to take the messages to Guatemala City several times a day, Mr. Reiley reported.

The station, in the Hall of Science, normally serves to demonstrate amateur radio operations for visitors and tourists. According to Mr. Reiley, the hall and the station now shut down Mondays and Tuesdays, because of the city's financial straits, even though it is operated by a private nonprofit body.

NEWCOMER COMMENTS

But because of the Guatemalan disaster, volunteers like Mr. Reiley come in to operate the station as they have in previous emergencies, such as the earthquake in Nicaragua, in 1972.

One of them, Mr. Eiselen, is a 71-year-old retired service manager who got his license a few years ago from what Mr. Reiley termed the largest amateur radio school in the United States, an adjunct of the Hall of Science.

"I'd been fooling with shortwave radio ever since I was a kid," Mr. Eiselen remarked, "but I always wanted to become a real radio ham." He said that if Mr. Reiley needed him again today, he'd be there.

Wolfgang Saxon

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* * * * *

At 4:04 am on February 3rd, a killer earthquake dealt a swift and unsuspecting blow to the sleepy country of Guatemala.

Roofs, walls and entire buildings crashed down, killing, injuring and trapping thousands of citizens of Guatemala City and surrounding towns and villages. Power, water, and telephone lines were disrupted by falling buildings. Fires in various parts of the city burned out of control for the lack of water pressure in fire fighting.

Frantic searches began for friends, relatives and loved ones. Muffled cries could be heard from persons buried in tons of rubble. Men, women and children dug frantically among fallen structures to help those trapped beneath. Far too often, help arrived late, as another individual died.

The initial hours were the worst, for no one knew the extent of the damage. With nearly 100% of communication facilities disrupted, the only way for messages entering or leaving the country was via radio sources. Unfortunately, most radio communications were inoperative due to the lack of emergency power.

Once the news of the disaster reached the amateur radio community, hams in the western hemisphere, and in the United States particularly, focused their attention and abilities on the shaken country.

The disastrous earthquake gave hams another opportunity to show dedication and expertise in establishing communication channels to facilitate the passing of emergency traffic between the U.S. and Guatemala.

Previous experience in traffic handling through the Red Cross, AREC, Local, Area, and Regional NTS gave hams the confidence and practical experience to step in and set up communication networks within hours of the disaster. This proved the effectiveness of the National Traffic System in training operators to handle messages during an emergency.

Hundreds of ham operators across the American continent were actively participating — either passing/receiving traffic, or assisting by monitoring emergency frequencies.

Many amateurs know the correct operating procedures used during an emergency, and, by virtue of their experience, are a helpful asset to the net control station who is trying to coordinate the incoming/outgoing traffic.

Others who are not acquainted with traffic handling can turn a smooth operating net into a nightmare. Many hams who participated in the Guatemalan crisis know of this first hand.

It is hard to state the exact rules of emergency operation that should be observed. Each situation may be different. However, there are general rules that should be followed.

1. *QRM.* Do not transmit without listening. This is probably the most important rule to follow explicitly. Many times during the Guatemalan crisis, amateurs would break in and call CQ or ask what net is in operation. Someone would have to tell the fellow he is on an emergency net, thereby adding additional QRM to answer his question — or net control would have to tell him to stand by until he could pick him up. In most cases, portions of traffic would have to be repeated because one person did not listen before transmitting. Multiply this by several hams doing this every five minutes and you can begin to understand the problems it causes in net operations.

Kids and adults monitor the traffic from station WB2JSM by using handsets provided, while station personnel collect and call out traffic within.

Another unforgivable amateur "sinner" is the ham who calls net control and says, "This is WA5??. I am just standing by listening. Can I be of any help?"

If you are really interested in helping, you will monitor the frequency until a request for assistance is transmitted by net control.

Remember, only you can keep the QRM level down.

2. *Accuracy.* In message handling, this is all important. Do not try to impress the station you are transmitting to by sending beyond their copying speed. If you are receiving the message and the station is going too fast, ask him to QRS. It takes just as long to answer requests for "fills" as it does to send at an appropriate speed the first time.

After trying a full day to deliver a message to California from Guatemala via land line, I finally asked the operator to check the number. Because one digit was transmitted incorrectly, a mother had to go through another sleepless night before she learned that her son was alive and well.

Remember, speed is not requisite, but accuracy is.

3. *Authenticating messages.* During an emergency, all messages, and especially official ones, should be written and signed by the originating party. A telephone number on the message where the signatory party can be reached is also advisable. This is normal procedure for routine messages during an emergency, too.

Remember, you are responsible for all messages transmitted from your station. So be sure your messages have authenticating signatures.

Message handling is not everyone's forte, but if you want to be of service during an emergency situation, at least inform yourself of the correct operating procedures.

There are two very helpful booklets that may be ordered from the ARRL: *Operating An Amateur Radio Station* (THE COST IS A NOMINAL 50 CENTS) and *Public Service Communications* (FREE). These two booklets will give you everything you need to know except the practical experience which comes with on-the-air operation.

I don't believe I will ever have a higher satisfaction than having been able to deliver a message to someone to tell them his loved ones were alive and well.

One memorable phone call to a Spanish-accented lady will always mean something special to me. When she answered the phone, the operator said, "This is a long distance collect call from an amateur radio operator who has a message for you from Colonel Juan Ortega (name changed) in Guatemala Cit . . ." The operator had not finished the sentence when the excited lady interrupted saying, "Oh yes, yes. That's my son! That's my son!"

Once I delivered the message informing her that her son was alive and well, she said, "You will never know how much it means to me to receive this message. Ever since the earthquake, we didn't know if our son was alive or dead. God bless you for helping to find my son — God bless you all."

Daniel L. Kayser WB8VZX
Willard OH

A Representative Democratic Republic?

Not long ago, the ARRL, through *OST*, announced its interest in becoming involved in repeater coordination. Their idea was to appoint regional ARRL frequency coordinators to either work with existing councils or, in some cases where no coordination exists, become the coordinating facility. It was stated that the reason for this was to recognize the fine work now being accomplished by individual coordinators and/or coordinating councils and thereby give official League backing to this work. While I totally agree that official League recognition of repeater coordination efforts will lend a lot of much needed credence to this work, I and others I have talked with are bothered by two distinct things. First, it is not clear who would be "top dog" in such a setup: the existing council or the ARRL-appointed coordinator. If a case should arise in which the two found themselves diametrically opposed on a given matter, whose decision would be final? Secondly, the concept of "appointing" a person to this position by an organization outside a given area, rather than permitting all interested amateurs from within that geographic area to "elect" one of their peers to that position, does not seem exactly fair. The very reason for the success of most coordinating councils has been the fact that they are elective bodies rather than appointive. Thereby, every amateur involved in such efforts feels that, through the electoral process, he or she does truly have a voice in matters.

Finally, I consider the League proposal a bit shortsighted in that it is designed only to recognize repeater frequency coordination and is thereby not totally representative of all VHF/UHF oriented amateurs and all VHF/UHF operation in various modes. For example, it gives no assurances whatever that the rights of non-FM interests will be protected in the future. It is my feeling that any large scale frequency coordination effort must be total. It must not only be voluntary and elective, but must also represent every special interest and mode operating VHF/UHF, including such specialties as ATV, SSB, OSCAR, RTTY and yes, even AM. It must guarantee some voice to all, since it will be the amateur – not the League or any organization – that will ultimately decide the destiny of any band and mode.

Now please don't think that I doubt the League's sincerity in this matter; quite the contrary. I strongly believe that the League is sincerely looking out for the welfare of the overall amateur community. Frankly, I know of no other individual or group within our community with the capabilities of properly representing us to Washington and to the rest of the world. If I felt any other way, I would not have joined it. About the only thing that bothers me in regard to the League is their "hang-up" on having to always "appoint" rather than elect, especially to positions such as we are now discussing. In my mind, the position of League Area Coordinator is as important as the position of Division Director. He or she will be holding a good part of a given geographic area's VHF/UHF spectrum utilization in his hands, and therefore I feel that those affected by decisions of such an individual should have the ultimate decision as to just who such an individual will be. But, is this still the best way – or is there another alternative? I think that there is.

The idea that I am about to pass along is just that: an idea. A starting place from which to go forth. Admittedly, it has faults (no plan is perfect), but it meets two prime prerequisites. First, it is as close to being perfectly democratic as is possible. Other than for procedural matters, there is no single individual appointed by any other group or individual. From the local "grass roots" level to the upper echelon, all those serving are elected by their peers, elected by their fellow amateurs as their representatives. Secondly, it allows amateurs involved in VHF and UHF to totally determine, within the framework of the Commission's Rules and Regulations, the future development of that part of the amateur spectrum. In this way, we can be assured of uniformity in nationwide growth and thereby provide positive leadership and direction internationally. Starting to sound interesting? Well, all this is possible only if all amateurs interested in the future of VHF and UHF communication are willing to get involved.

Total involvement of all interested amateurs is the simple key. The idea is to build a national voluntary frequency coordinating council, one that would not only look out for the welfare of repeaters, but also would represent all aspects of VHF and UHF operation. Refer to Fig. 1; this is how it would be built. A city, state or other geographic area interested in working on such a plan would form "Workshop Groups" made up of individual amateurs of similar interest. These "Workshop Groups" could take the form of local coordinating councils such as we now have only for repeater owners, or perhaps the less formal "club" approach. Since I live in Southern California, let's use it as an example. Southern California is a given geographic area with two functioning VHF coordinating groups already in existence. Two meter and 220 MHz repeater systems are coordinated by the Southern California Repeater Association, while systems on 50 MHz and 450 MHz and up are the coordinating job of the California Amateur Relay Council. Such organizations as these would continue to operate without any change except for one small item, this being the election by the general membership of such organizations of a representative to a regional coordinating body to be described later on.

Now let us suppose that there soon developed a lot of SSB activity on two meters (and such is quick becoming the case in many parts of the nation as multi-mode transceivers such as the Multi-2000 and and TS-700, to name but two, proliferate among the amateur ranks). An area SSB users Workshop or Council could be formed locally to set up specific guidelines as to operational parameters of this mode, if the amateurs involved thought it was necessary. For example only, let's assume that the SSB Coordinating Council decided that a number of specific frequencies should be voluntarily set aside as designated calling frequencies. In a like manner to the repeater council, they could coordinate the same and ask that all amateurs voluntarily, and that word must be underscored, *voluntarily*, respect these allocations. We must never forget that no one amateur or group of amateurs owns or has a god-given right to any specific frequency.

RTTY enthusiasts, ATVers, AMers, OSCAR users, etc., could form their own representative area group to coordinate efforts of amateurs involved in that given mode and/or band. Regularly, these area groups would have their elected representatives meet locally to discuss and hopefully solve on a local level problems either between or common to some or all. They would learn to interact with each other and develop lines of communication that would be of mutual benefit. Never again could an amateur say, "Well, I was not asked my

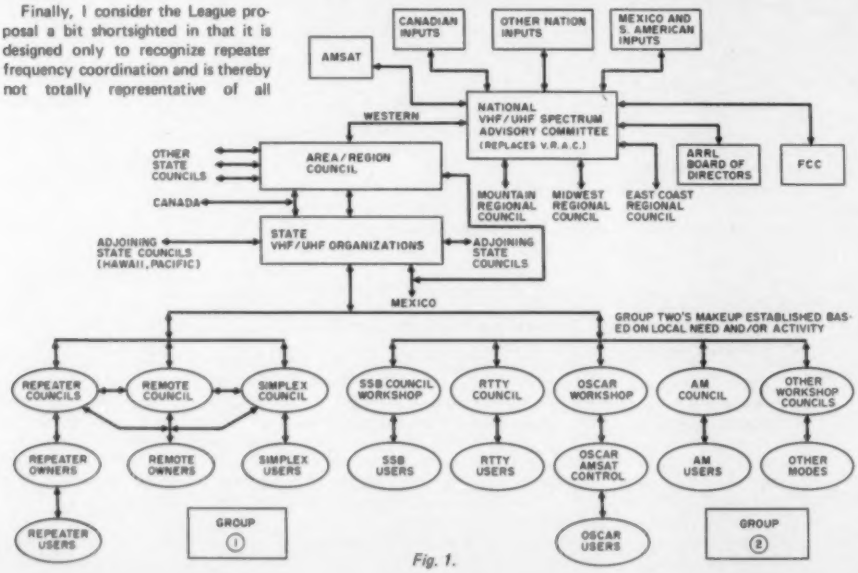

Fig. 1.

be my guest

visiting views from around the world

opinion on this matter." The forum for his or her specific special interest would be there if he or she had the interest to make their voice heard. That excuse would be gone.

Also of note is that users of a specific mode or band segment would be responsible for solving their own problems unless such problems involved users of a different mode or band segment. If an AM station, let's say, were playing havoc with SSB operations, the two Workshop Councils involved could get together to solve the dilemma. Other interest groups need not get involved, and indeed should not, unless requested to try to help mediate the dispute as a disinterested third party. While total intercommunication would exist between all such groups, no one group would ever become "king of the hill" over the other groups.

Keeping with our example, the logical next step is some form of statewide organization made up of elected representatives of each of the just described local groups. The statewide organization would be comprised of elected representatives of each of the interested local groups, i.e., repeater council, remote owners council, AM users council, etc. Such a group would not get involved in local matters between its members, unless it involved solving a problem that had occurred between two neighboring groups of the same interest. Then only members of groups of similar interest would get involved in any form of the mediation or solution effort. That is to say, should a problem develop between two neighboring RTTY organizations, only members of the statewide council involved in that particular mode and acting as delegates from other RTTY groups would get involved. Repeater council representatives, SSB group representatives, and all other parties would keep hands off unless asked to help mediate the problem. Basically, the statewide organization would only involve itself in matters that were impossible to solve on a purely local level.

Another important responsibility of the statewide organization would be to establish and maintain lines of open communication with adjoining statewide organizations. Since radio signals do not observe "the state line," problems between adjoining states might occur from time to time. It would be the prime responsibility of these statewide organizations to solve such problems on this level. For example, the South Podunk Repeater Association in Texas and the XYZ Repeater Committee in New Mexico both coordinate a repeater to 147.84/.24 at the same time and they happen to be geographically separated by only 50 miles. The way things seem to be today, a repeater war would probably be imminent unless one of the systems were to move. But who is to move? Obviously each repeater would demand its rights and complain bitterly to whoever coordinated it to get that "other machine" off its frequency. With little or no interaction and intercommunication between coordinators, as we have today, a problem such as this would be somewhat insurmountable. But what if there was good communication between neighboring coordination efforts? First, if this were the case, it is doubtful that a problem such as this would ever happen again. A simple exchange of proposed allocation lists and a few telephone calls could solve such a problem before it ever starts.

OK, though, let's pretend (hopefully) that we have such an outstanding problem at the time such a coordination effort is initiated. The first thing would be for the two area coordinating bodies to arrange for representatives of both organizations, along with both system owners, to get together and start talking, rather than hurl brickbats at one another. It is simply amazing what can actually be accomplished when feuding parties learn to communicate rather than hurl insults. On both sides of the continent I have personally seen such happen after all other methods of solving such problems have resulted in a dead end — and I mean all methods! If it were pointed out on a technical level that there was available something as simple as a shift in antenna pattern or a much better channel pair for one of the systems, and that such information was going to be made public to the entire local amateur community (since it was in their best interest to know that machine B would technologically function far better if it was willing to bow to the will of the majority — ah, here we get into peer pressure once more!), then machine B would be hard put to justify its stand on the matter. The same would hold true for machine A if it were deemed that its stand was unreasonable. Again, the entire secret, if it must be deemed such, is for members of the amateur community to learn the art of personal, open-minded, two way communication, and develop lines of interaction from this. Again, though, it should be stipulated that the only people who should be involved in such negotiations are those

Continued on page 78

Children Need Discipline

There has been a good deal of concern expressed by members of the amateur fraternity over many of the Commission's actions in recent times — surprisingly enough, even *deregulation* is being met with resistance and even hostility in some quarters. Much of it is simple inertia, the well-known natural human reluctance to accept change of any kind. And, "We need rules, stiff rules, with teeth — otherwise, the service will become a shambles," is an oft-heard reaction these days.

One also hears the statement, "Children need discipline."

The latter might perhaps be true — for children. The former? Let's look first at some of the Commission's recent deregulatory actions in other services, notably broadcasting, commercial, and even CB.

Broadcast: Inspections of equipment reduced to once weekly instead of the former five days out of seven; deletion of the requirement for station frequency monitors; allowance of 125% positive peak modulation for AM; allowing operators to log meter readings at three-hour intervals, instead of half-hourly. All of this, and more, in recognition of "state of the art." Modern broadcast equipment simply does not need the attention that earlier gear — around which the earlier rules were tailored — required.

Commercial: Deletion of the requirement for annual frequency, modulation and power measurements. This, finally, in recognition of the fact that the majority of two-way shops make these measurements routinely whenever a radio requires servicing — and if a radio is operating satisfactorily, these parameters probably *are* within tolerance.

CB: A general relaxing of a whole set of highly restrictive rules that were almost universally ignored by a vast majority of users. This, along with a reduction in license fee, has resulted in a swing toward more users actually becoming licensed, more use of call-signs on the air, and thus — however infinitesimally — more effective supervision and enforcement. (Ah yes, but what about the "sliders"?)

So now, what of the recent moves deregulating *our* service?

Relaxing of licensing rules for repeaters, particularly with regard to the technical showings, for instance: true recognition of "state of the art," the "art" in this case being the technical excellence of just about every repeater ever put on the air by an amateur group. (To say nothing of the saving of time and paperwork for the Commission itself!)

Logging: No one says you *can't* keep a complete log if you so wish; the new skeleton requirements meet the Commission's needs for enforcement purposes and lighten the record-keeping burden all around.

Cross-banding: A generally desirable permission, and, so far at least, with little or none of the "cluttering up" of the bands with the indiscriminately dumped signals that many amateurs feared.

And now, the latest proposal: Eliminating of the "portable" and "mobile" designators. It is presumed that we will be allowed to say those words if we wish, and, where necessary for clarification, surely we will continue as we always have. In situations where there's no real need for anyone to know if we're at home or away or rolling or still, we'll be able to save a few words, a few seconds of air time.

Really, from this seat at any rate, we should feel complimented that we are being recognized for the generally well-disciplined, well-motivated group that we know we are, and that our technical prowess is being equated with that of the people in the broadcast and commercial fields. Genuine progress in any human endeavor should never be feared, should indeed be welcomed with open arms. We *are* making progress, and the move toward deregulation certainly seems to be official recognition of the fact.

Jim Sealey WB8MTD

Reprinted from The Action Mini-Mag, *Cascades Amateur Radio Society, Jackson MI.*

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LETTERS

I insist that you print ev

MUSHIE

Since my father, Sen. Edmund S. Muskie, was not involved in this year's New Hampshire primary, I thought I had heard the last complaint of him being "indecisive, soft, or mushie on the 'issues.' " But then I received my April copy of *73* and noticed that the "issue" was addressed to "S. Mushie." Was it a political comment or just a coincidence that I received it on the day after the February 24 primary? It probably doesn't mean mush to you, but if you correct the mailing label I might consider taking you up on your great $17.76 offer for a three year subscription extension. I am now studying for a ham license after being absent from ham radio for more than ten years. I had a subscription to *73* for several years about 1964 when I was licensed as WN3DCB (Democratic Congressman's Boy) in Washington. The changes in ham radio and in *73* since that time are very exciting. I really enjoy working with and learning about ICs. Good luck – hope to work you some day on CW, Wayne.

Stephen Muskie
Saco ME

NOT TOO BAD

Well, you've done it again. I've just taken my Feb. issue of *73* out of the mailbox, read it from cover to cover, enjoyed every page of it, and got the urge to write to you again!

First of all, on your comment on R.F.I., I own and operate with two friends (both hams) a stereo, CB, and amateur equipment shop. We both sell and service most makes of home entertainment equipment and I must admit that there is nil in any kind of shielding for rf energy. We have found that 98% of all of the inexpensive and expensive stereos, tape players and such have no really good shielding. All of them have open chassis (no bottom plate), wood or plastic cabinets (not even foil around the inside) and I don't think that the manufacturers ever heard of by-pass caps on the ac line! We have found ways to eliminate most cases of R.F.I. from AM/FM and SSB amateur and CB sets; if any of *73*'s readers want some help, have them write me at the shop and I will be glad to pass along some of the information that we have compiled over the past 2 years on elimination or reduction of R.F.I. problems.

Second, on CBers getting into ham radio. Ever since we have opened the shop, I have kept my IC-2F tuned to the 01-61 repeater in New Haven CT. We have quite a lot of activity on the machine, and I like to listen to the local boys rather than the mess on ch. 19. When the local CBers come in for service or just to chat for a while, they always are attracted to the IC-2F. After a demonstration of 2m FM, some interest is kindled, but usually fades after an explanation of how to get a license. This happens quite a bit, but 2 of them showed more interest and asked questions and showed a real interest. To make a long story short, they both passed the test and are now licensed as WA1VVR and WA1VXH. Both are very active on 2m, and are starting to get on RTTY – not too bad for a couple of CBers. I think that if any ham will take the time to show what ham radio is about, get the spark kindled, and help them with the code and theory, most CBers can and do become good ham operators as these two people have shown to us here. Also, we have started classes for the Novice and General class licenses at the store; enrollment now stands at 26, with 19 of them now in CB. I'll keep you posted on their progress, and on the dropout rate (which I think will be high, but you never can tell).

I'm sorry to be so long-winded, but your editorial stirred my mind – which doesn't happen too often. Keep up the good work at *73* and maybe ham radio can benefit from your wisdom.

Tom Cullen K1WXK/W1MXZ
Audio Associates
1213 Old Colony Rd.
Wallingford CT 06492

THE REAL ONE

I have read with great interest the article on a "Startrek Communicator" in the February issue of *73*, because my younger son is a dedicated Trekkie. When I showed him the article, however, he informed me that the described device obviously was an inferior fake. As apparently every true Trekkie knows, the full description of the real Starfleet Communicator, Type 1, including circuit diagram and parts list, is contained in the Starfleet Technical Manual. On Planet Earth this manual (copyright Franz Joseph Designs) is distributed by Ballantine Books, 201 East 50th St., New York NY 10022. The Manual, which is not classified, is apparently available in many bookstores. The circuit diagram is very interesting and I think the designers of ham radio equipment could learn quite a lot from the simplicity and efficiency of this design. After all, to get a range of 12,000 km (7500 miles) with a three-transistor hand-held transceiver on 27.125 MHz during the bad part of the sunspot cycle is not really easy. But maybe it is the Starfleet Communicators which are responsible for some of the funny signals one can hear at around 11 meters (440 inches) if one has a general coverage receiver.

Erich A. Pfeiffer WA6EGY
Granada Hills CA

LET'S GET BACK

I have been a licensed and very active ham for 15 years now and have yet to understand what computers and citizens band radio criticism have to do with the hobby.

Every time I pick up *73 Magazine* from the mailbox, I am hit in the face, directly, from cover to cover, with either massive advertisements for computers (for who knows what) or some outrageously priced two meter rig, which is nothing more than a "legal" CB radio any more.

I am sorry to say that 98% of the articles in the magazine don't even fit the average wealthy amateur, let alone the non-wealthy one.

Don't get me wrong, I am not an "old fogie" on this subject but am simply wondering why the sudden change from an interesting amateur radio publication to a technical manual for sophisticated design engineering of computers, with a little CB humor thrown in to break up the monotony?

I am active on Oscar 6 and 7 so I don't hate VHF in any way other than the way it is used on the FM segment. I can hear the same junk on a single channel CB radio for much less than $250-$300 for a two meter rig.

Let's get back to amateur radio; if I wanted to learn about computers or how high a price I could pay for some cheap transceiver, I would certainly subscribe to a magazine designed for that type of audience.

Gary N. Babcock WA5BMN
Portales NM

GET THE WORD OUT

Have really enjoyed your technical articles, primarily those on I/O. One of your advertisers has a unit for sale, a Univac 769 line printer, and I sure would like to get in touch with these users. I have one and need to find out how to interface it to a computer. Would like to set up sort of a clearing house on applications, parts, etc. If anyone is interested, my phone is 817-292-5211, or you can write:

Jim Beistle WB5BLX
3728 Wilkie Way
Ft. Worth TX 76133

P.S. Hope you can get the word out and keep the good articles going. Who knows? I might even write one someday.

ROY ROGERS' HORSE

I sympathize with all who have had dealings with a certain firm (same name as Roy Rogers' horse) and have run up against a stone wall.

After a four month exercise in futility with the above firm and the famous Miss "D" (if you've talked or have written to her, you know who I'm referring to!), I decided it was time to seek outside help. The route I took was consumer protection and action was swift and satisfactory. I had my money refunded within two weeks after contacting them.

So, if you have a similar problem, get in touch with the Consumer Protection Agency (Chicago directory assistance can give you their address and phone number). They will be most helpful in getting your hard-earned dollar back.

I hope I've been helpful without being too vague and that Wayne will see fit to print this in *73*.

In closing, I'd like to say thanks for a fine magazine. The articles are interesting and informative, the format is great and the magazine is well worth the subscription cost.

Art Krugaluk WN1UUP
Wilmington MA

The letter by WA6EVX/KG6 in the April issue sounded much like my own unhappy dealings with Trigger Electronics. I spare you the details in order to propose several solutions which are all but guaranteed to work. 1. Write one more letter to Trigger. Review the essentials of your transactions specifying original order date, catalogue order number, if possible. Be specific about what you want, goods or refund, or refund only. Ask for the courtesy of a prompt reply. Enclose a copy of your cancelled check, front and back sides, or money order receipt. Put the material in an addressed envelope, but do not seal it! Go to the post office and talk with the postmaster about registered and certified mail, then tell him the whole

story. He will take it from there and you will hear from Trigger pronto. Two friends used this approach and got their merchandise quickly. Federal mail inspectors are bad news to mail order houses.

2. Write a second letter to the Assistant Attorney General, Chief of Consumer Fraud Section, 134 North LaSalle Street, Room 204, Chicago IL 60602. Briefly tell the story of your unsatisfactory dealings with Trigger. Include a copy of your check, and all previous correspondence. Give as complete a picture as possible. If you want help on how to tell your story, the number is 312-641-1988.

3. Send copies of this second letter to the following:

a. Mr. J. Thomas Rosch, Director, Bureau of Consumer Protection, Federal Trade Commission, Washington DC 20580.

b. Trigger's bank: Operations Officer, Oak Park Trust and Savings Bank, Lake, Marion, and Ontario Streets, PO Box 269, Oak Park IL 60301.

c. Better Business Bureau, 430 North Michigan Avenue, Chicago IL 60611.

d. Chamber of Commerce, 948 Lake Street, Oak Park IL 60611.

e. Legal Department, Trigger Electronics. Registered mail, restricted delivery, requires a signature which will be returned to you, providing you a name for a good stiff shot on the phone (their number is 312-771-8616).

It seems proven that appeals by individuals to the company are futile, but collective action by a number of people who have some muscle and punch behind them in the form of federal, state, and local agencies gets results. There is a growing tide of interest in consumer protection and we should both make use of and contribute to it.

David A. Fee WBØPTM
Brookings SD

KUDOS

By the way, thanks for having SD Sales as an advertiser. I'm sure you have heard many good things about them, but I would like to add my two cents worth. Their service is great, their prices outstanding, and the quality of their merchandise is hard to beat. I think this is one of the few companies, along with others like VHF Engineering, that *truly* has the amateur at heart.

Ed Picha WB9IMV/9
Urbana IL

After procrastinating for quite a while I had to write and tell you about the service that I recently got from S. D. Sales in Dallas, Tex.

I bought two clock kits complete with xformer and PC board. I put both kits together and found that they ran fast, and also one LED segment was defective in one of the kits. I wrote them about this and PROMPTLY received a reply from them. With the reply I got the necessary parts to correct the problem. What was unusual about this was, unlike some other kit mfrs, S. D. Sales included a schematic as to the placement of the parts, more condensers than were needed, and not just one replacement LED readout, but a complete set of SIX! That is what I call really going out of their way to insure customer satisfaction. By the way, both kits work beautifully.

Frank K. Burnham
Olympia WA

P.S. You've got a great magazine. Keep up the good work.

Let me add my kudos to Bill Godbout Electronics out in California. The clock kit I ordered from him arrived by airmail (cost him $2.75 — how does he make a profit on a $14.50 clock??) less than two weeks after I mailed in the order. He didn't even wait for the cheque to clear. Now that's service!!

Keep up the good work at *73* and let's have many more articles on computers.

D. E. Hausman VE3BUE
Waterloo ONT

YASME HISTORY

Our YASME DXpedition operation of 3D2KG is now history. The first QSO was with WA8JUN on 28 Jan 76 and the last QSO was with UA1OB on 23 Feb 76.

A total of some 7500 QSOs were made with amateurs in 113 countries, thus assuring that 3D2KG will eventually qualify for DXCC. Approximately one half of the QSOs were on CW and one half on SSB.

Operation on both phone and CW was held on 10, 15, 20, 40 and 80 meters. Openings into Europe were fantastically good and over 1000 QSOs were had with Europe. It was noted that there was a long path opening to Europe from 0630 to 0830 GMT, followed occasionally by a short path opening from 0900 to 1100 GMT.

Approximately 1000 QSOs were had during the first half of the ARRL Phone DX Competition, which was followed by another 1000 QSOs during the ARRL CW DX Competition. Good openings were had to all parts of the US and Canada on 10 meters during the CW and SSB ARRL contests, but almost no signals were heard on 10 meters during daily checks at other times. Similarly, lots of CW and SSB stations were worked on 80 meters during the contest weekends, but not many at other times.

All continents were worked (WAC) in 28 minutes, 20 Feb 76 on 14mc phone. Stations QSOd were: TU2GA, 0712; IØIJ, 0719; ZP5LX, 0726; JA7SGV, 0729; AH3FF, 0737; and W7TX, 0740 (time in GMT).

The station equipment, the Kenwood Twins and a Heathkit 230 amplifier, worked fine with no failures during a two month period with a grand total of nearly 20,000 QSOs from VR1Z, VR8B and 3D2KG.

It is expected that the next stop will be at Nauru. Please pass this information to all interested persons.

Lloyd Colvin W6KG
Iris Colvin W6DOD
Suva, Fiji Islands

FERMENTING CATALYST?

I remember several years ago when you and *73* were a great help to me back at White Sands (Missile) Proving Grounds and when I used to pick up a copy of *73* for 37¢ at the Yucca newsstand at Alamogordo, N.M. And now again I'm asking for a little assistance in communicating with any of *73*'s readers who might be in the Frankfurt-am-Main, Hanau or Weisbaden areas and are interested in minicomputers (and particularly those who may be planning to build around on 8080 miniprocessor, like I am).

Have just returned two days ago from a three week visit to the States and catching up on copies of *73*. What's this I read about Wayne getting out of BYTE? It won't have the same ole catalyst fermenting.

Will be looking forward in a year or so to be back in the USA and getting my General.

C. Norton Smith WN4FMB
APO New York

PLEASE RETURN

Please, if it is at all possible, return to the Table of Contents format that includes the name or call letters of the author. Many times it is easier to look up an article by referencing the call rather than the name of the article.

Bill Voight WB8YJE
Dayton OH

You're right. Done. — Ed.

KEEPING PACE

I read with interest the letter which you printed in your March issue concerning the cardiac pacemaker. Since I am deeply involved with same and have been for over 10 years, I am writing the following information to you:

Cardiac pacemaker, since its first implant over 12 years ago, has gone through quite a revolutionary change. Even up to and including seven years ago, demand type pacemakers could be shut off or reverted to a continuous mode via such imbalance as an electric shaver, ignition coil on a car, television receiver or a microwave oven. The new cardiac pacemakers made by Cordis or any other large manufacturing company are not susceptible to external stimuli.

Recent reports indicate that, because of failsafe circuitry, only by presence near a high power radar transmitter can a demand type pacemaker revert to a continuous mode. A microwave oven will also revert the pacemaker if the patient wearing the device is a midget and can somehow crawl inside.

A magnetic field in the proximity of a demand pacemaker merely alters the function to a continuous mode and does not hinder the patient from receiving the voltage stimuli.

I hope this will help Mr. Hudson and any of your other readers that may have such a device installed.

Joel H. Kornreich K2QBV
President, Cardiotronics, Inc.
Lyndhurst NJ

BICE-ENTENNIAL

Sometimes I disagree with you, but not often. At present you and *73* are tops. I can only see wasted paper in the new size magazine. Larger type and no real advantage of more material.

You may remember that I wrote to you personally because I wasn't getting BYTE. I heard from you that you weren't involved in the mag., so I wrote directly to them and threatened action through the Attorney General of New Hampshire. Well, that produced results immediately. I got the back issues and the current magazines and also a duplicate of the first 4 issues. I would say that they caught up on my subscription at last.

Incidentally, on *73*, I got the April issue yesterday (the 28th of February). Wow, that is really getting ahead of all other magazines.

Now, all I really want is real simple information in an article or somehow that will tell me what I want to know about computers and how they operate and of what use they are going to be to me and why I should build one and so on.

In the March issue I got some of the answers, so I hope you will continue to have articles that will enable poor dummy me to learn and see if I can use and even build a computer.

W7MEU — John Swafford, I believe, a phone co. man and hep on this stuff — is building a computer with the latest micro miniature stuff in it and plans to offer them for sale to the small business man or sell time on his to small business men. How about that?

I finally retired — so I say I am now unemployed. Hah! Don't you believe that, because I am busier than ever. Work that has piled up for years around here — dig this, plant that, paint this, lower this ceiling, make the bathroom modern, and I have enough work for a year steadily and what about ham radio — ugh, not any time except for my Army MARS net. I have a used motor home that needs much work before we can travel and I

won't move it till the work is done. So I bet we don't go anywhere this year. I want a 2m rig synthesized that will reach 148.01 and they just don't make that yet. I did buy a 2m Standard Walkie-Talkie SRC146A the other day – a distress sale. Complete with all the goodies except charger, nicads, carrying case, rubber ducky, crystals, unused, $250. So as soon as Standard gets the crystals here, I will use it for the interim. Oh, will I give some of the guys in parades a shock when I break their (net) parade communications frequency from my Circus Wagon as I traverse the parade route while playing my Calliope. I give a small WAC certificate for all who work me in parades. What? WAC certificate? – Sure, *Worked Al's Calliope*.

I'm removing the 94 simplex cuz it ain't used here. I'm adding another channel that is used more out here. 04-64.

Knowing you are busy, you don't have to answer this letter unless you want to, and I won't be mad. If I ever get over that way, I'll really have to stop by and see if you still have your Brooklyn accent. I'll expect a full VIP tour of your facilities.

I sure marvel at what has been accomplished with the FCC by the talks you and others have had with them in the last year. Keep up the good work.

Oh, yes, as you can see by my stationery I am the top man in the Knights of Pythias in this state for a year, until October. I tell everyone that this is my year, get it – BICE-entennial. I get laughs and groans, but it's fun to spring it on 'em.

I'm a fraternal man by nature, so belong to many – Odd Fellows, Masons, Knights of Pythias and all the side organizations of each group – ladies groups, also. Takes lots of work and evenings. Being a musician, I could play every night of the week because organists and pianists are hard to find for that kind of work, especially ones who actually play so that those doing floor work actually have something to "march to" while traversing the many patterns. Each to his own, I guess.

Keep up the good work with that *73 Magazine* and I hope you finally beat the IRS and the phone co.

Alden N. Bice K7JZT
Seattle WA

Good to hear from you Alden. Watch for better use of the bigger pages, at least in 73. Watch also for a lot more interesting things on microcomputers. Have always enjoyed your calliope QSL card. By all means plan on a visit when up this way ... still have my Brooklyn accent when needed ... very handy in New York – Wayne.

LET'S CHANGE

WB4SNC's comments (*Be My Guest*) touch on the subject of foreign fone stations running traffic in the so-called "American" fone band of 14.2-14.35 MHz.

The Managua and Guatemala disasters point up the very real need for Americans to have the right to work foreign voice stations in the 14.1-14.2 MHz portion of the 20 meter band.

Let's change those antiquated regulations to read:

> U.S. Amateur radio stations may utilize the 14.1-14.2 MHz segment of the 20 Meter Amateur band to conduct voice communications with other than U.S. Amateur stations. (NO communications between U.S. stations, except disaster emergency traffic, foreign or domestic.)

The new format, and your efforts to give us more for our money, are greatly appreciated. *73* – a very fine magazine!!!

Virgle H. Meador W4LVZ
Miami FL

PLUG IT IN WHERE?

Since my second hobby is raising sled dogs, I enjoyed the April cover. A question, though: Where do you plug the transceiver in? All in all, I'll bet this eliminates the ignition noise that you complained about a couple of issues ago.

Rich Racicot WA1TIQ
Merrimack NH

DEAR LEW

The American Radio Relay League
Lew McCoy
225 Main St.
Newington CT 06111

Dear Lew McCoy:

At the November meeting of the Michigan Area Repeater Council, your letter was read and discussed. After a lengthy discussion, and although strong FCC support is highly desirable, the MARC voted to go on record as being strongly opposed to the ARRL proposal for these reasons. The ARRL has already amply demonstrated its incapability of providing the national leadership in this frequency coordinating and other fields. These include such failures as the present mess on 450 MHz amateur band planning; failure to promote acceptance of the ARRL 6 meter band plan; the lack of technical and political leadership in providing state of the art information, commercial standards, and political considerations; the failure to have established a national 15 kHz splits policy; failing to promote cooperation between the present repeater councils and such groups as RACES and others. There has been a general failure to promote good operating procedures on VHF. The amateur world has a proud history of self-policing on HF. On HF the ARRL 00 program has helped many amateurs. However, this program apparently was never extended to VHF, where it is needed desperately. The ARRL has continually looked down on the Technician class amateur as a fourth rate ham. The only positions available to the Technician in the ARRL organization are almost not worth mentioning. Many Technicians, however, are more technically capable than many higher class amateur licensees. The ARRL should be encouraging manufacturers to upgrade built-for-amateur-use equipment and discouraging such practices as including "94" simplex crystals in VHF FM equipment. The only formal meeting between the FCC and amateur radio operators in the history of the FCC and the ARRL was not even attended by the ARRL. The ARRL should be involved with helping establish national policies and working with local repeater councils. It must be remembered that the ARRL does not represent all us amateur radio operators, and that some amateurs will have nothing to do with the ARRL. The MARC will not be subservient to the ARRL communications department.

We would like this letter published in *QST*.

Terry Babenko K8RUR
Chairman
Lloyd Ellsworth AA8ZCO
Secretary-Treasurer
Michigan Area Repeater Council
Belleville MI

BEST SYSTEM

Thanks a lot for the 14 wpm tape. Two 20 minute sessions/day for about two weeks got me over the hump. Passed Advanced exam yesterday. ARRL led me astray and cost months of lost time.

I.W.C. Hamlin WN3ZLM
Havre de Grace MD

Just a note to let you know I really enjoy your mag. Also think you have the best system for learning the code. Passed my General on 1/13/76 – haven't seen the ticket, yet. Wonder what the holdup is?

Glenn Waldrum WN5NQW
Sherman TX

P.S. Would like to see more articles from John Murray W1BNN!

FIRST TO MAKE SENSE

Just finished reading the January issue, and in comes the February issue. When am I supposed to find time to read my other magazines? I'm not complaining, just saying wow what an issue. All of the articles were great, but I have to comment on one in particular. That one is "What's All the Noise?" by Mr. Roukas W2DNY.

Now, I've read a lot of articles on noise figure, and this is the first one that made any sense to me. (I have a 1st class FCC license and am not exactly a dumbbell on electronics.) This is the first time I have ever seen anyone write that noise figure was a ratio or measure of the amount of noise a receiver adds to the signal passing through it. Now I have to go back and read all those other articles with this new insight. They all probably said it, but not clearly.

Roger C. Galbraith WA3TCO
Guys Mills PA

A COUPLE OF SUGGESTIONS

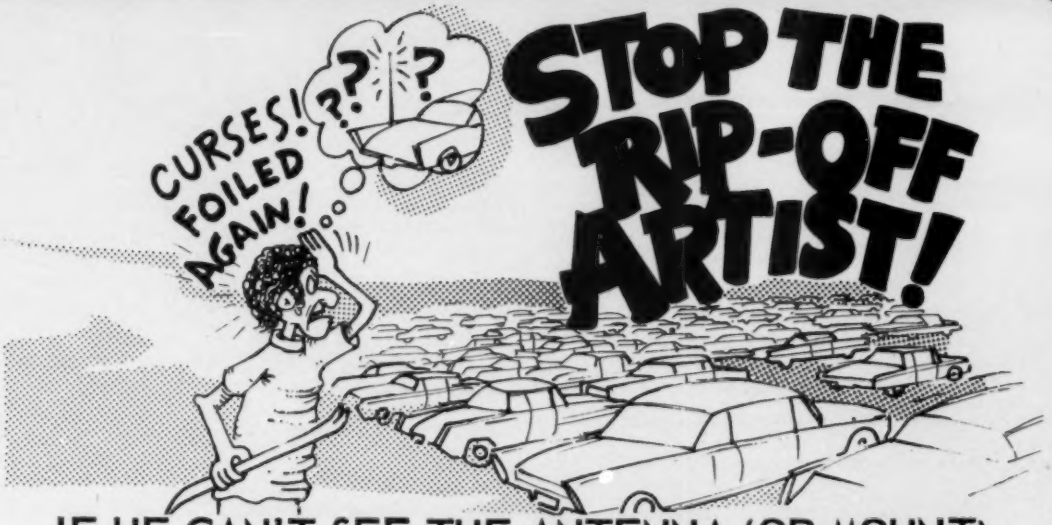
I would like to sincerely thank Mr. John Harrington for his most inspiring article in the February, 1976 issue of *73*: "You Can Make Photo PC Boards." This article aroused a long-dormant interest in photography, and helped me make some outstanding (if I do say so myself) PC boards for a local repeater system.

A couple of suggestions might be in order for those who cannot find Naccolith film, as used in the article. I used Kodalith Ortho Film, Type 3, and Kodalith Developers (a two-part solution), quite successfully. This film seems to be quite a bit more easily available than the film called for in the article ... at least in this part of the country. Naturally, exposure times must be compensated for with this type of film. I have found that an extremely short exposure (½ second) to a No. 2 photoflood is adequate with Kodalith, or, a three second exposure to average room light seems to work just as well. A couple of test runs will quickly determine what works best.

Also, I find that making a paper proof of the negative works beautifully for keeping mistakes off of expensive board stock. I make a paper contact print of the negative using "Velox" film and Dektol developer. The paper proof makes it possible to see any potential problems on the negative ... any lines that are not crisp and clear, any overexposure of the negative, and any excessive problems with dirt showing up as clear spots on the negative. I use this proof, if all the lines are clear and good, to draw in all the components with a red pen, showing all component leads and clearances, and drawing in all components and jumpers. This stops any problems with one too few component pads, improper component clearances, and wiring errors. Also, this proof makes the final wiring of the completed board much easier.

And, for thoroughly professional-looking boards, Pres-Type or any type of instant press-on lettering can be used to personalize your board. Component points and board terminals can be identified easily using this kind of type, because it will photograph and be etched just like the lines on the

Continued on page 113



IF HE CAN'T SEE THE ANTENNA (OR MOUNT) HE DOESN'T KNOW WHICH CAR TO HIT!

The SouthCom FOILER can save the loss of your valuable mobile unit by removing all evidence of your unit when you leave your car! It is well known that the mobile 2 way radio is now the prime object of thieves, now comprising up to half of the reported thefts in some areas! The thief knows that the quick way to find his target is to scout parked cars for antennas or antenna mounts. (The practice of removing the antenna and leaving the mount showing is no real deterrent.) The SouthCom FOILER allows you to stow your antenna and mount in your trunk in 10 seconds, leaving no external evidence of your unit to attract would be rip-off artists.

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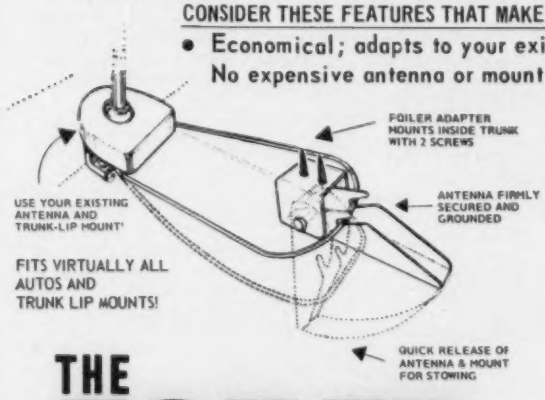
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DEALER INQUIRIES INVITED

CONTESTS

Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

FOUNDATION TO AWARD SCHOLARSHIPS

The Foundation for Amateur Radio, Inc., a non-profit organization with its headquarters in Washington, D.C., announces its intent to award three scholarships for the academic year 1976-77. All amateurs, wherever resident in the U.S. and holding an FCC license of at least General class, can compete for one or more of the awards if they plan a full-time course of studies beyond high school.

The John W. Gore Scholarship pays $750. Applicants must intend to pursue a career in electronics or a related science and have completed at least one year in an accredited college or university toward a baccalaureate or higher degree. Preference will be given to residents of the District of Columbia, Maryland, and Northern Virginia.

The Richard G. Chichester Scholarship also pays $750. Applicants must be members of the ARRL and be sponsored by an ARRL-affiliated club. There is no restriction on the course of study, but applicants must be enrolled in or have been accepted by an accredited university or college and intend to seek a baccalaureate degree. Preference will be given to residents of Ohio, Kentucky, Indiana, Illinois, the District of Columbia, Maryland, and Northern Virginia.

The Edwin S. Van Deusen Scholarship pays $250. Applicants must have been accepted or enrolled in an accredited 2 year technical school and intend to seek an Associate degree in a science-related area. Area preference is the same as the Gore Scholarship.

Application forms can be requested from the Chairman, Scholarship Committee, 8101 Hampden Lane, Bethesda, Maryland 20014. Requests must be postmarked prior to June 1, 1976.

The Foundation is devoted exclusively to promoting the interest of amateur radio and to scientific, literary and educational pursuits that advance the purposes of amateur radio.

CALENDAR

May 14 - 16*	YL ISSBers QSO Party
May 15*	World Telecommunications Day – Phone
May 15 - 16	Armed Forces Day Communications Tests
May 15 - 17*	Michigan QSO Party
May 22*	World Telecommunications Day – CW
May 22 - 23	New York State QSO Party
May 22 - 23*	Wisconsin State QSO Party
May 23 - 24	Nostalgia Radio Exchange
June 4 - 7	IARS/CHC/FHC/HTH QSO Party
June 5 - 6	Minnesota QSO Party
June 12 - 13	RSGB National Field Day
June 12 - 14	West Virginia QSO Party
June 12 - 14	ARRL VHF QSO Party
June 26 - 27	ARRL Field Day
July 3	Straight Key Night
July 3 - 4	QRP Summer Contest
July 17 - 19	CW County Hunters Contest
July 24 - 25	ARRL Bicentennial Celebration
Aug 7 - 8	10-10 Net Summer QSO Party
Aug 14 - 15	European DX Contest – CW
Aug 21 - 22	SARTG Worldwide RTTY Contest
Aug 21 - 23	New Jersey QSO Party
Sept 4 - 5	ARRL VHF QSO Party
Sept 11 - 12	European DX Contest – Phone
Sept 25 - 27	Delta QSO Party
Oct 8 - 10	CD Party – Phone
Oct 9 - 10	RSGB 21-28 MHz Contest – Phone
Oct 16 - 17	RSGB 7 MHz Contest – CW
Oct 16 - 18	CD Party – CW
Oct 30 - 31	CQ Worldwide DX Contest – Phone
Nov 5 - 8	IARS/CHC/FHC/HTH QSO Party
Nov 6 - 7	RSGB 7 MHz Contest – SSB
Nov 6 - 8	ARRL Sweepstakes – CW
Nov 13 - 14	European DX Contest – RTTY
Nov 14	OK DX Contest
Nov 20 - 22	ARRL Sweepstakes – Phone
Nov 27 - 28	CQ Worldwide DX Contest – CW
Dec 4 - 5	ARRL 160 Meter Contest
Dec 11 - 12	ARRL 10 Meter Contest
Dec 31	Straight Key Night

* = described in last issue

SOWP BICENTENNIAL CW QSO PARTY

The first weekend in June 1976 has been set aside by the Society of Wireless Pioneers (SOWP) for their Bicentennial CW QSO Party. The activity will start at 1200 hours GMT on Saturday June 5th and end at 2400 hours GMT on Sunday, June 6th. Suggested frequencies for the event are 55 kHz up from the low end of each band. Members with Novice licenses should use the mid-frequency of each Novice band. The call will be CQ-SOWP.

Stations will exchange signal report, QTH (city and state) and SOWP membership numbers. A special certificate will be awarded to all member stations who contact 10 or more fellow members. Stations desiring a certificate should submit a list of contacts made – showing callsign and SOWP membership number of the station worked. Submissions should be made not later than June 15, 1976 and should be mailed to: Bill Willmot K4JPF, V.P.-P.R., 1630 Venus Street, Merritt Island FL 32952.

BITING BUG AWARD

A plaque and $50 prize are being offered to the writer of the best article about ham radio published in an American non-ham radio publication during 1976. Articles will be judged on how well they attract non-hams to ham radio, based on subject matter, style, accuracy, illustrations, and mention of where a reader may obtain more information about ham radio. The type of publication and circulation will also be considered, with youth magazines being judged higher.

All entries must be submitted by January 31, 1977 to: Ray Collins WA2GBC, Harter Road, Morristown NJ 07960. Send a photostat of the article along with the name and date of the publication.

SPESM BICENTENNIAL CERTIFICATE

The Society for the Preservation and Encouragement of Six Meters is offering a Bicentennial Certificate for working any 5 members between January 1, 1976 and December 31, 1976 on 50 to 54 MHz any mode. Send date, time, call letters, and SPESM Membership Number along with a check or money order payable to Dan Atwell, for $1.25 to cover printing and postage costs. Send application to: The SPESM Club, Bicentennial Committee, P.O. Box 768, South Elgin IL 60177.

WORKED RAAG MEMBERS AWARD

The award is issued by the Radio Amateur Association of Greece for contacting members after January 1973 as follows: Class 3 – DX stations work 15 SV RAAG members, EU stations work 50 SV RAAG members; Class 2 – DX stations work 30 SV RAAG members, EU stations work 75 SV RAAG members; Class 1 – DX stations work 50 SV RAAG members, EU stations work 100 SV RAAG members.

ATHENS CITY AWARD

This award is given for contacting stations resident in the city of Athens, GREECE after January 1973 as follows: Class 3 – DX stations work 10 SV stations in Athens, EU stations work 20 SV stations in Athens; Class 2 – DX stations work 20 SV stations in Athens, EU stations work 30 SV stations in Athens; Class 1 – DX stations work 30 SV stations in Athens, EU stations work 50 SV stations in Athens.

For either award: No restrictions on band or mode and club station SV1SV counts as 3 for DX or 5 for EU in all classes. QSLs are not required to be sent. Send application showing log copy certified by two other hams or a club official and 12 IRCs or $2 to award manager, SV1IG, Anastasios Panos, P.O. Box 564, Athens, GREECE.

CAIRNS CENTENARY AWARD

All stations outside of the Cairns, Australia area are eligible for the award (outside 100 mile radius of Cairns). VK and ZL stations must QSO with 3 Cairns area stations while overseas stations need only QSO with 2 Cairns area stations. Send a copy of log details to CARC, VK4HM, P.O. Box 1426, Cairns, 4870 QLD AUSTRALIA.

Awards will be forwarded in bulk via bureaus unless the cost of postage and packing is remitted. The award will be available for the entire 1976 year. The following list shows the Cairns area stations – VK4s: TL, MH, SU, ZCS, YG, AMO, NF, ZBU, AE, NU, ZY, ZNZ, RY, HK, YT, ZIP, HM, VI, CI, ZIB, KV, VT, QX, NI, DJ, DB.

27th ANNUAL ARMED FORCES DAY COMMUNICATIONS TESTS

Starts: 1300 GMT Saturday, May 15
Ends: 0245 GMT Monday, May 16

This year's observance of Armed

Forces Day marks the 27th anniversary of an annual event reflecting the long-standing good relations between the amateur radio fraternity and our military radio stations. These tests give amateur operators their yearly opportunity to demonstrate superior technical skills and receive proper recognition for their proven expertise. The proceedings include crossband operations in CW, SSB, and RTTY receiving tests. Special commemorative QSLs will be awarded to amateurs achieving a verified 2-way contact with any of the participating military stations. Special certificates also will be sent to amateurs who receive and accurately copy the Armed Forces Day message from the Secretary of Defense, as transmitted in both CW and RTTY during the receiving tests.

The military stations WAR, NAM, NPG, and AIR will transmit on military frequencies and listen for amateurs transmitting in those portions of the amateur bands indicated on page 130. The operators at the military stations will specify that portion of the amateur sub-band they are tuning.

CW RECEIVING TEST:

Receiving test will be conducted at 25 wpm, broadcast will be a special Armed Forces Day message from the Secretary of Defense to all participants. A ten minute CQ call for tuning purposes will begin at 0300 GMT May 16th. The message will be transmitted precisely at 0310 GMT from the following stations:

WAR – 4030, 6997.5, 14405; NAM – 4012.5, 7385, 14386; NPG – 4005, 6989, 14375, 49.995 MHz and 143.995 MHz; AIR – 7315, 13997.5.

RTTY RECEIVING TEST:

The RTTY test will be transmitted at 60 wpm. A ten minute CQ call for tuning will begin at 0335 GMT May 16th with the message beginning at 0345 GMT. Transmission will be from the following stations:

WAR – 4030, 6997.5, 14405; NAM – 4012.5, 7385, 14385; NPG – 4010, 7347.5, 13922.5, 148.410 MHz; AIR – 7315, 13997.5.

SUBMISSION OF TEST ENTRIES:

Transcripts should be submitted "as received" with no attempt to correct possible transmission errors. Indicate on the page containing the test: time, frequency, callsign of station copied, your name, call (if any), and address. Entries should be postmarked no later than 25 May 1976 and submitted to the respective service copied.

Stations copying NAM and NPG should send entries to: Armed Forces Day Test, Chief, Navy-Marine Corps MARS, Building 17, 8th Street & South Courthouse Road, Arlington VA 22204.

Stations copying WAR should send entries to: Armed Forces Day Test, Commander, United States Army, Communications Command, ATTN: CC-OPS-OM, Fort Huachuca AZ 85613.

Stations copying AIR should send entries to: Armed Forces Day Test, Air Force Communications, Service/DOYF, Richard Gebaur Air Force Base MO 64030.

NEW YORK STATE QSO PARTY

Contest Periods:
1600 GMT May 22 to
0400 GMT May 23
1200 to 2359 GMT
May 23

Stations may be contacted once on each mode (phone and CW) on each band. NY stations may work other NY stations. Mobiles and portables changing county may be reworked by out of state stations.

EXCHANGE:

RS(T), serial number starting at 001, and QTH – county for NY stations; state, province, or country for others.

FREQUENCIES:

CW – 1810, 3560, 7060, 14060, 21060, 28060. Phone – 3975, 7275, 14285, 21375, 28575. Novice – 3725, 7125, 21125, 28125.

SCORING:

Score one point per QSO. NY stations multiply QSO points by the total number of states, provinces, and countries. Non-NY stations, multiply QSO points times number of different NY counties worked (62 max).

ENTRIES:

Number the first contact for each new multiplier in logs. A check sheet is requested from stations working over 100 contacts. Entries should be sent no later than June 30 to: John C. Yodis WA2EAH, 43 Beacon Avenue, Albany NY 12203. Results will be sent only to those enclosing a large SASE. Appropriate certificates will be issued.

SPRING NOSTALGIA RADIO EXCHANGE

Starts: 1800 GMT Sunday,
May 23
Ends: 0100 GMT Monday,
May 24

Sponsored by the Southeast Amateur Radio Club K8EMY of Cleveland, Ohio, the contest is open to all amateurs. The object is to restore, operate, and enjoy older equipment with like-minded hams. A Nostalgia Radio is any equipment built since 1945 but at least 10 years old – an advantage, but not required in the exchange. The same station may be worked on each mode on each band, but no AM phone below 21 MHz. General call on CW is "CQ NX," on phone "CQ EXCHANGE." Non-contestants may also be worked.

FREQUENCIES:

CW – 70 kHz up from low band edges. Phone – 3910, 7280, 14280, 21380, 28580. Novice – 3720, 7120, 21120, 28120.

EXCHANGE:

Name, RS(T), state-province-country, transmitter type (home brew send P.A. tube, i.e., "807"), and other interesting pleasantries.

SCORING:

Add the numbers of different transmitters, states-provinces-countries for each band. Multiply by the total number of QSOs; non-contestants' QSOs count one, NX QSOs count three. Multiply that total by Nostalgia Multiplier: total years old of your transmitter and receiver (if transceiver, multiply years old by 2). Different equipment combinations may be used; in that case figure scores separately for each and combine for total score.

AWARDS:

Certificates are not awarded for highest scores, rather for unusual and ingenious experiences, circumstances, achievements, etc.

ENTRIES:

Send logs, comments, pictures, anecdotes, etc., to W8KAJ, 2386 Queenston Road, Cleveland Heights OH 44118.

NOTE: There was a small response to the first Exchange last December, so the Exchanges will be held on a three times a year basis. Why not try this "FUN" contest and make some new friends!

IARS/CHC/FHC/HTH QSO PARTY

Starts: 2300 GMT Friday,
June 4
Ends: 0000 GMT Monday,
June 7

An SASE to K6BX will bring detailed information. Contest is open to all amateurs and SWLs worldwide. Same station may be worked on each band and mode, SSB and AM are different modes.

EXCHANGE:

QSO number, RS(T), name, CHC/FHC number, US state and county or similar division. Non-members send HTH instead of CHC/FHC number.

SCORING:

CHCers – score 1 point per QSO with other CHCers, 2 points per QSO with HTHers; 1 additional point if YL, B/P, FHC, Novice, CHC-200, Merit or Club station, or if on VHF/UHF; double above points if QSO is outside own country.

HTHers – contacts with other HTHers count 1 point, with CHCers count 3 points. Rest same as above.

SWLs – use above depending on whether CHC member or not.

MULTIPLIERS:

Each different continent, country, ITU zone, and US state counted only once.

FINAL SCORE:

Multiplier times total QSO points is final score. Multi-operator stations divide score by number of operators.

FREQUENCIES: (for US and DX as allowed)

CW – 3575, 3710, 7070, 7125, 14075, 21075, 21090, 21140, 28090, 28125.

Phone: 3770, 3775, 3790, 3943, 3960, 7070, 7090, 7210, 7260, 7275, 14320, 14340, 21360, 21440, 28620.

AWARDS:

Hundreds of certificates and trophies in all categories and divisions are awarded. An SASE will bring further information from K6BX. Send all requests and logs to: International Amateur Radio Society, K6BX, P.O. Box 385, Bonita CA 92002. Logs should be mailed within 15 days after the close of the QSO Party.

MINNESOTA QSO PARTY

Starts: 0001 GMT, Saturday
June 5
Ends: 0500 GMT, Sunday
June 6

Sponsored by the Heartland Amateur Radio Club with a possible special events call station (call unknown at this time). No restrictions as to mode or operating time; use 160 to

Continued on page 130

RESULTS

RESULTS OF 5th ANNUAL SARTG WORLDWIDE RTTY CONTEST

Single Operator, top ten world scores:

Class A, up to 100 Watts		Class B, over 100 Watts	
I6VGA	133,955	I1PYS	229,320
F6ALL	85,760	CT1EQ	204,590
PAØRZ	49,060	I1AA	204,000
WØYDJ/4	36,960	OD5HC	167,750
LA7AJ	23,230	HB9AVK	147,600
G3RDG	19,080	ON5WG	121,980
SL5AR	16,975	W3EKT	114,725
LA2IJ	13,230	WA3JTC/ZP	113,425
OK2BJT	9,240	4X4MR	107,250
OK1MP	7,705	SMØOS	96,815

Special classes – top five scores:

Class C, multi-operator		Class D, SWLs	
DLØTD	239,370	Wolfgang Geller	154,000
HA5BKM	98,890	I3-13018	100,160
OZ7RD	44,800	I3-14258	93,130
OK1KSL	41,065	I4-14707	58,575
HAØKDA	22,880	JA1-3477	1,750

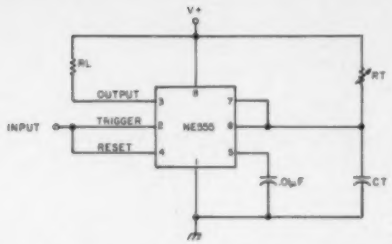


Fig. 1. Basic timer circuit. The time delay is determined by the component values of R_t and C_t and may be calculated from the equation: t(sec.) = 1.1 R_t (Ohms) x C_t (farads). The timing diagram for this circuit is shown in Fig. 2.

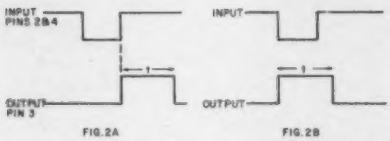


Fig. 2. Fig. 2(a) shows the timing diagram for the basic timer circuit of Fig. 1. Fig. 2(b) shows the timing diagram that would result if the reset terminal were tied to V+ rather than to the input terminal.

One of the auxiliary circuits essential to the operation of a repeater is a COR, or carrier operated relay. To date, a number of COR circuits have been designed, utilizing a variety of active devices (tubes, transistors, op amps, UJTs, etc.) to provide a number of auxiliary repeater control functions. However, few of the previously presented designs have been truly complete. Some designs presented timing circuits and auxiliary repeater control circuits but avoided the rather sticky task of interfacing the logic circuits with the high impedance circuitry of the still popular commercial tube-type FM receiver. Other designs detailed elaborate circuitry for impedance matching to the receiver, but ignored the auxiliary circuits necessary for the convenient, practical operation of a repeater. Still other designs employed timers and auxiliary circuits of dubious stability.

The digital COR described in this article employs state of the art solid state devices, allowing simple and compact construction, as well as providing stable, reliable and convenient repeater operation. The input circuit is specifically designed to interface with commercial tube-type FM receivers.

The versatility of the digital COR is best described by detailing the functions it was designed to perform:

1) The most basic function of keying the repeater transmitter upon detection of a carrier on the repeater input frequency.

2) A squelch tail timer – this timer provides a delay between the time the reception of carrier ceases and the time the repeater transmitter drops out, a necessary feature for consistent copy of mobile stations in fringe areas.

3) A three minute timer that will "lock out" the repeater transmitter should there be a continuous carrier of longer than a three minute duration detected by the repeater receiver.

4) A means of resetting the three minute timer without letting the repeater transmitter drop out. Many of the previously designed CORs have provided for resetting of the three minute timer only upon dropout of the transmitter, necessitating an annoying squelch tail burst at the end of each transmission, and causing unnecessary wear and tear on the COR relay. In addition to providing a means for resetting the three minute timer a fraction of the way through the squelch tail time delay period, the digital COR also provides a means for an audible indication when this has been accomplished. A DPDT center-off switch has also been included with which two other modes of resetting the three minute timer may be selected.

5) A means of keying or disabling the repeater transmitter via a remote contact or digital logic signal applied to the COR. This feature has been included to make the COR compatible with remote control devices, monitor receivers, code and voice identifiers, etc.

Circuit Building Blocks

One of the basic building blocks of the digital COR is the NE555 timer IC. Since this IC has been described in numerous articles in past issues, only the most salient characteristics will be repeated here. The reader who desires additional information is urged to consult the references listed at the end of the article.

Fig. 1 shows the external component connections of

Super COR

--digital ... of course!

Mike Connor WA0BMP
3611 North Shore Dr.
Clear Lake IA 50428

and

Bob Henson WB0JHS
105 Northview Dr.
Waukee IA 50263

the basic timing circuit. The timing diagram for this connection is shown in Fig. 2(a). With the reset terminal connected to the trigger terminal, the timing cycle is initiated on the trailing edge of the input pulse. The output, pin 3, remains at a logic "1" voltage during the timing cycle, the duration of which is determined by the values of R_t and C_t.

As depicted in the timing diagram of Fig. 2(b), the timing cycle would begin on the leading edge of the input pulse if the reset terminal were connected to V+ rather than to the trigger terminal.

Fig. 3 shows how an NPN transistor can be added to the basic circuit to provide an auxiliary reset feature. A positive voltage applied to the auxiliary reset input will cause C_t to remain discharged, and prevents completion of the timing cycle.

The timing diagram for this circuit is shown in Fig. 4. Note that the output switches to a logic "1" voltage at time (1), the trailing edge of the input pulse. However, the timing cycle does not actually commence until the auxiliary reset input returns to a logic "0" at time (2). The output then returns to a logic "0" t seconds later as determined by the values of C_t and R_t.

The other IC employed in the digital COR circuitry is the SN7400 quad NAND gate. For those not familiar with logic circuitry, Fig. 5(a) shows the commonly used symbol for the two input NAND gate. Fig. 5(b) shows the truth table that governs its logic output.

One final circuit building block is necessary to build the digital COR. This is the circuitry that provides a digital "on" or "off" signal to the logic circuits depending on the presence or absence of a carrier on the repeater input frequency. This is accomplished by the circuit shown in Fig. 6.

Q1, an N-channel JFET, provides impedance matching between the high impedance of the receiver and the considerably lower impedance of the logic and timer circuits of the COR. Q2 and Q3 comprise the analog to digital portion of the circuit, providing either a logic "1" or "0" voltage at the collector of Q3 depending upon the magnitude of the analog signal at the drain of Q1.

A negative going voltage in the receiver during reception of carrier will cause a corresponding increase in the drain voltage of Q1. The magnitude of the drain voltage sufficient to cause the collector of Q3 to switch from a logic "1" to a logic "0" is determined by the setting of the 5k Ohm trimmer.

Note that the collector and emitter of Q2 are reversed from the conventional biasing arrangement in order to provide a sharper switching characteristic.

Composite Circuit Description

We can now proceed with how the building blocks just described can be utilized in the design of the digital COR. Fig. 7 shows the simplified

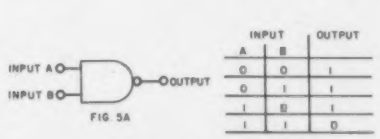


Fig. 5. Fig. 5(a) shows the common logic symbol for a two input NAND gate. Fig. 5(b) shows the truth table for the two input NAND gate.

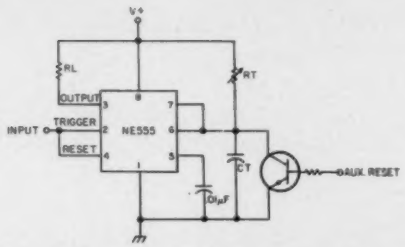


Fig. 3. The addition of an NPN transistor and resistor provides an auxiliary reset feature. The timing diagram for this circuit is shown in Fig. 4.

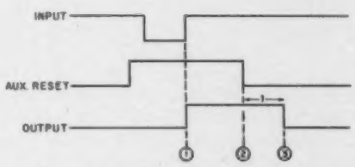
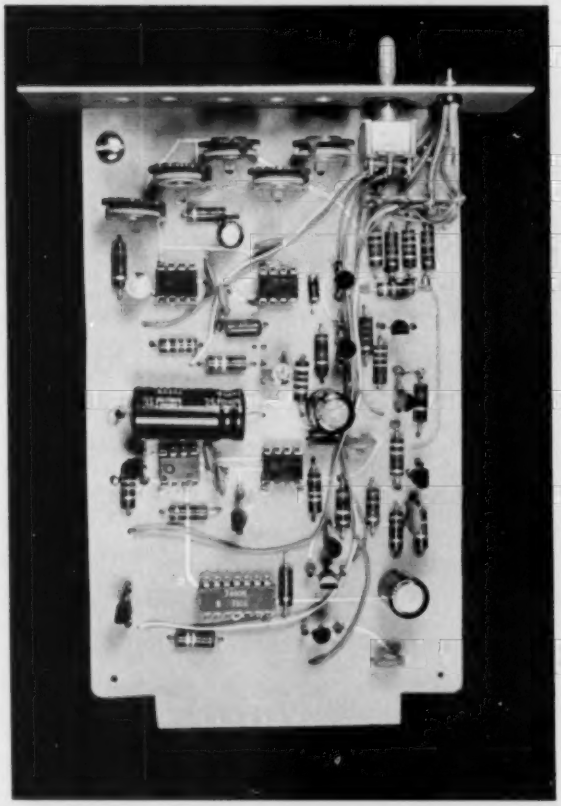


Fig. 4. Timing diagram for Fig. 3.

logic diagram of the composite circuit. For the sake of clarity, some timing components, bypass and coupling capacitors, and input circuitry have been omitted from this diagram. The timing diagram for a typical transmission cycle is depicted in Fig. 8.

Referring to Figs. 7 and 8, the receiver detects a carrier



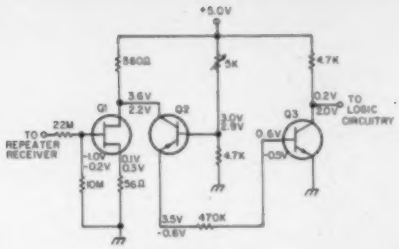


Fig. 6. Input matching and analog to digital portion of the digital COR. Top voltages are voltages during carrier reception conditions. The bottom voltages are taken during quiescent conditions. All voltage measurements are taken with a high impedance voltmeter.

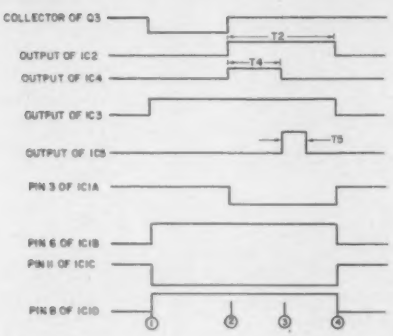


Fig. 8. Timing diagram for a typical transmission cycle, using the logic circuit shown in Fig. 7.

on the input frequency at time (1), driving the collector of Q3 to a logic "0" voltage. Remembering the truth table for a NAND gate shown in Fig. 5(b), the "0" on pin 5 of IC1B drives pin 6 of IC1B to a logic "1." This removes the "0" from the reset terminal of the three minute timer, IC3, allowing its output to go to logic "1," and initiating its timing cycle. With both pins 12 and 13 of IC1C at logic "1," pin 11 is driven to a logic "0." Section IC1D of the quad NAND gate simply inverts the output of section IC1C, providing a positive keying voltage to the transmitter keying relay or keying circuit.

At time (2) the carrier ceases, allowing the collector of Q3 to return to a logic "1" voltage. This removes the "0" from the reset terminals of both IC2 and IC4, allowing their timing cycles to commence. The outputs of both IC2 and IC4 are driven to the logic "1" state during their timing cycle. IC1A inverts the output of IC2, providing a logic "0" at pin 4 of IC1B. Thus pin 6 remains at a logic "1" and the transmitter remains keyed.

At time (3) timer IC4 times out and its output switches to a logic "0," keying timer IC5. The output of IC5 is a brief positive pulse of sufficient duration to discharge the timing capacitor of the three minute timer, IC3, reinitializing its timing cycle. The output of IC5 can also be used to provide a tone burst for audible indication that the three minute timer has been reset.

At this point in the transmission cycle the QSO could continue, the intervals between each of the subsequent transmissions needing only to be t4 seconds long (as determined by the timing components of IC4) in order to be assured that the three minute timer is being reset. The transmitter need never drop out during this time.

At time (4) the squelch tail timer, IC2, completes its timing cycle and its output returns to a logic "0." Pin 3 of IC1A is driven to a logic "1." The resulting "0" at pin 6 of IC1B forces pin 11 of IC1C to a logic "1." IC1D inverts this input and the transmitter drops out.

Note that if a carrier is present continuously for any length of time greater than three minutes, or if during a QSO of longer than three minutes there is no interval of t4 seconds or greater between adjacent transmissions, the three minute timer will time out. Pin 12 of IC1C would be driven to logic "0." Pin 11 would then go to a logic "1," and the transmitter would drop out.

D1 and D2 provide the remote keying and shutoff functions respectively. The COR will respond the same to a logic "0" remote keying signal on the cathode of D1 as it does to a local keying signal present on the collector of Q3. A "0" applied to the cathode of D2 will prevent the transmitter from being keyed, regardless of the status of the timer outputs or the local or remote keying voltages.

The actual schematic is presented in Fig. 9. Three light emitting diodes have been included for visual indication of circuit operation. The green LED indicates that a carrier or remote keying signal is being received. The red LED indicates that the transmitter

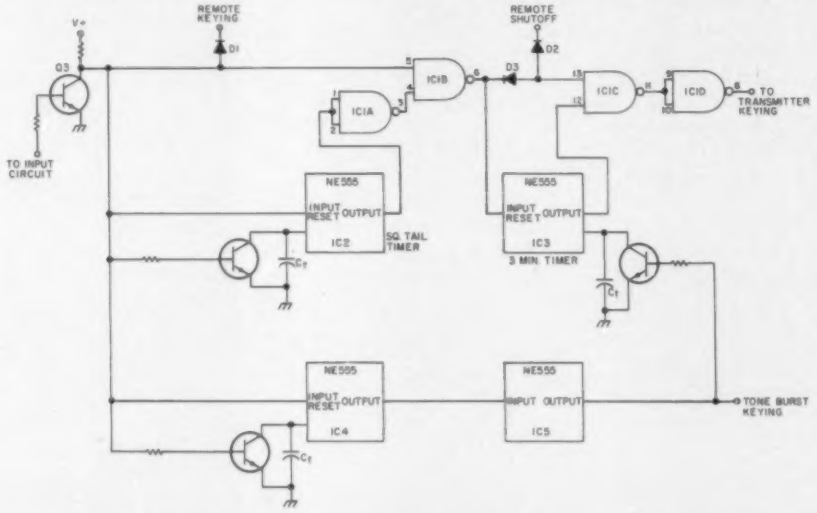


Fig. 7. A simplified composite logic diagram of the digital COR.

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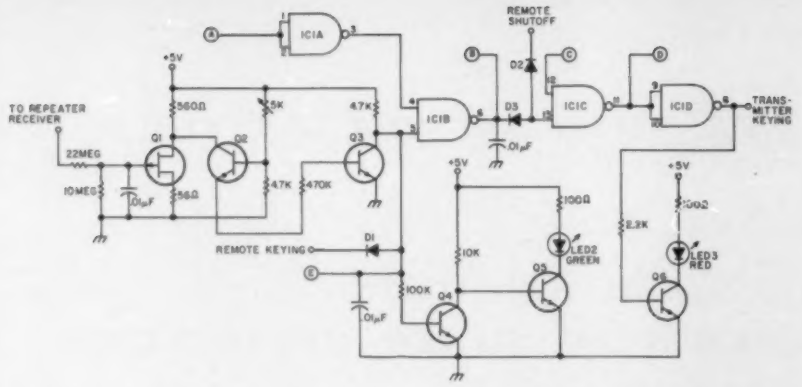

Fig. 9(a). Input and gating circuit for the digital COR. Encircled letters refer to connections to the time delay circuit of Fig. 9(b).

is being keyed, and the yellow LED will flash for the brief intervals when IC5 applies a reset pulse to the timing capacitor of the three minute timer, IC3.

The mode of COR operation may be selected by the position of SW1, a DPDT, center-off, switch. In the center-off position, the three minute timer will not reset until the transmitter drops out. In position 1 (the position of the switch in Fig. 9(b)), the three minute timer will reset the instant that the repeater receiver detects the absence of a carrier signal. In position 3, the three minute timer will be reset by a pulse from IC5, as described in the previous discussion of circuit operation.

Construction

The circuit board patterns for the digital COR are shown in Figs. 10 and 11. Due to the number of components in the circuit, a double sided circuit board was deemed a necessity to avoid the proliferation of wire jumpers that would have been required with a single sided board. The circuit board is designed to fit into a standard 15-pin PC board edge connector, though this could easily be modified for different connector arrangements.

Construction should be straightforward if the components are mounted as shown in Fig. 11. Bearing in mind that the circuit board is double sided, the components that must be soldered to both sides of the board should be mounted first. The remainder of the components can be mounted in any order.

There are no substitutes for the five ICs listed in the parts list. Fortunately, they are inexpensive, costing approximately five dollars for the lot.

The experienced builder is, however, encouraged to substitute bargain priced transistors for the HEP transistors listed in the parts list. Though the HEP devices will work with absolutely no problem, a substantial savings can be realized with a trial and error substitution of less expensive semiconductors.

The COR board should be mounted in a shielded enclosure. The connection of the repeater receiver to the input of the COR should be made with a shielded cable, since any rf or electrical noise introduced into the input circuit will result in erratic circuit operation. All other external wiring to the COR should be as short as possible, adequately bypassed at both ends, and shielded if the length is appreciable.

Checkout and Calibration

The calibration procedure is not at all difficult. A well regulated five volt power supply, a voltmeter, and a watch or clock with a second hand are essential. A calibrated signal generator would be convenient for the final adjustment but is not absolutely necessary.

First connect the power supply to the appropriate terminals as indicated in Fig. 11. The reception of carrier may be simulated by grounding the remote keying input with a jumper. With the aid of the watch or clock and the LED indicators, it is then possible to set the timing intervals of the four IC timers.

The final adjustment is that of the 5k Ohm trimmer in the input circuit. First, find a point in the receiver squelch circuit that switches from a slightly negative voltage during quiescent conditions to an even more negative voltage during the reception of carrier. In almost all of the tube-type

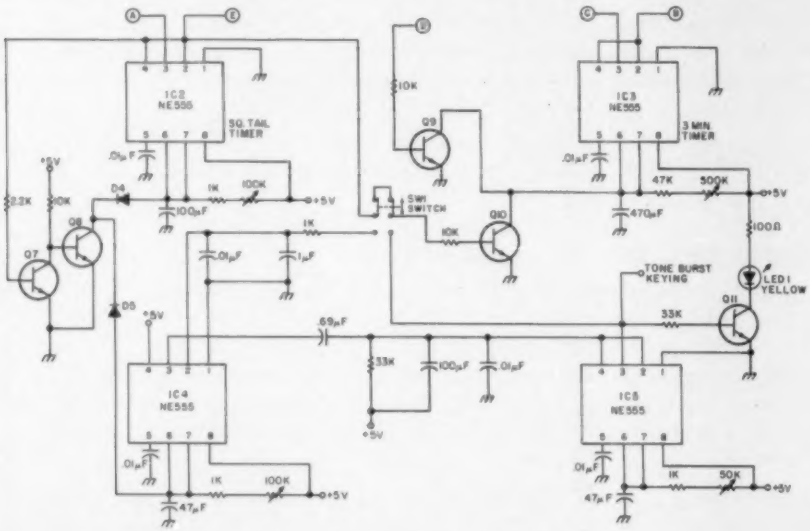

Fig. 9(b). Timing circuit for the digital COR. Encircled letters refer to connections to the input and gating circuit of Fig. 9(a).

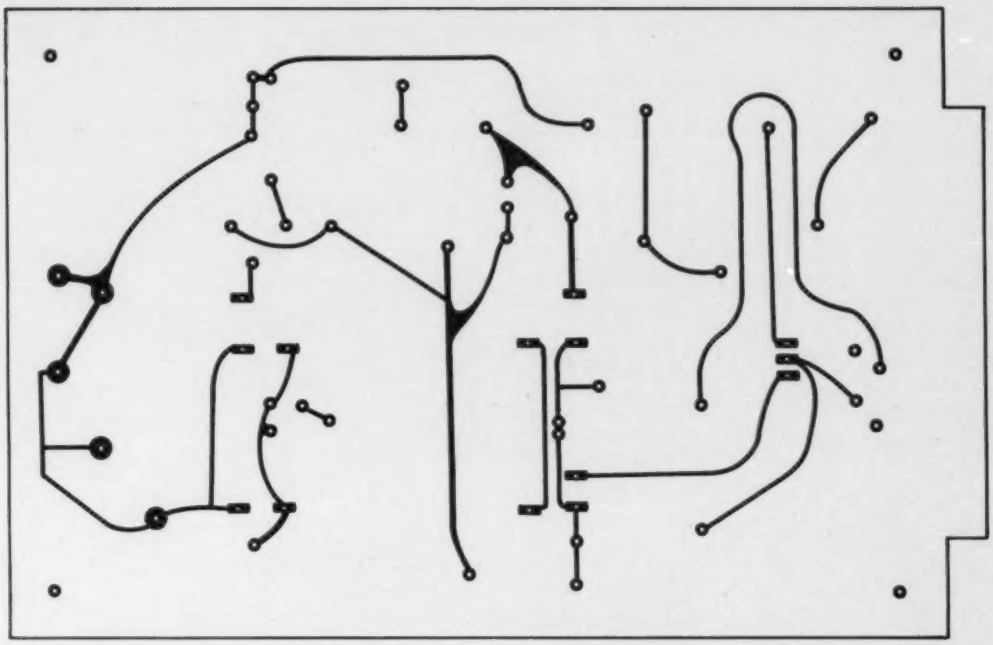

Fig. 10. Component side of PC board. The holes in the four corners should be used for pattern alignment during PC board etching.

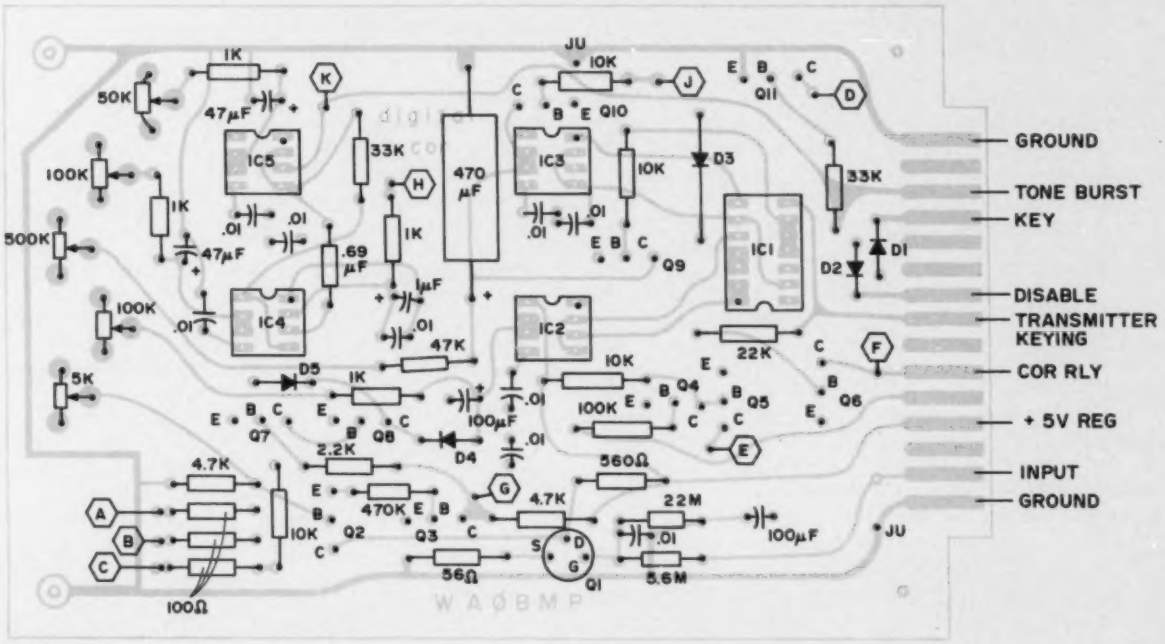

Fig. 11. Mounting diagram for the digital COR components. Note that this is a bottom view of the PC board. A wire pin must be soldered to both sides of the PC board at points marked "JU." External connections to the LED indicators and the switch SW1 are also shown.

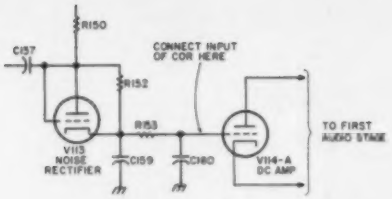

Fig. 12. Connection of the input of the digital COR to the squelch circuit of the repeater receiver. The circuit shown is a portion from a Motorola G-strip receiver. The connection point will be similar in other types of tube receivers.

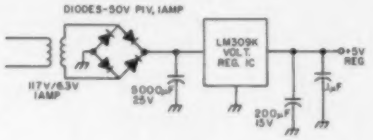

Fig. 13. Simple 5 volt regulated power supply.

commercial FM receivers the grid of the first stage following the noise rectifier has this characteristic. A simplified sketch of the squelch circuit of a typical tube-type receiver and the correct point of connection to the COR are shown in Fig. 12.

Once the shielded cable connection to the proper point in the receiver is made, determine if the squelch control threshold setting has been significantly altered. If so, the 10 and 22 megohm resistors must be substituted with ones of higher resistance. Some experimentation may be required to find the correct resistance values to match a particular receiver.

Next, inject a carrier signal into the receiver and adjust the 5k Ohm trimmer in the COR input circuit until the green LED lights at the desired level of receiver quieting. If consistent operation of the input circuit cannot be obtained for any setting of the trimmer, the ratio of the two input resistors will have to be varied, remembering not to let their sum be less than the value that will leave the squelch threshold setting unaffected. The voltage at the gate of Q1 compared with the typical gate voltage noted on Fig. 6 should be used to determine which way the ratio must be altered. The value of the resistor between the gate and ground must be increased if the amplitude of the gate voltage is significantly less negative than -1.0 volts during carrier reception. Conversely, this resistor must be decreased if the negative excursions of the gate voltage are significantly more negative than -1.0 volts.

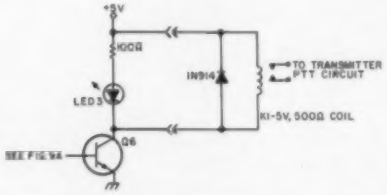

Fig. 14. The addition of a transmitter keying relay to the digital COR.

If a signal generator is not available, the input adjustment may be made by varying the squelch control to simulate carrier reception. Opening the squelch control until audio noise is heard roughly corresponds to the reception of carrier, thus causing the input circuit to switch "on" when the 5k Ohm trimmer has been suitably adjusted.

In all cases of difficulty, the typical voltages given in Fig. 6 should be used to help diagnose the problem.

This completes the settings and adjustments of the COR.

Optional Circuits

As was previously mentioned, the digital COR requires a well regulated five volt power supply. For those who don't have a personal preference, the circuit of Fig. 13 is suggested as the simplest and probably the cheapest available.

The digital COR was originally designed to control a solid state switch that did the actual transmitter keying. For those who prefer to use a relay to switch on the transmitter, the circuit of Fig. 14 is offered. The diode should be attached directly across the relay coil to prevent inductive transients from damaging the semiconductors.

Finally, Fig. 15 shows a simple tone burst circuit that can be used for an audible indication that the three minute timer has been reset.

Conclusion

The digital COR described in this article has been used successfully with both G.E. Progress Line receiver strips and Motorola Sensicon G-strip receivers. The COR is currently in use on the WRØAGZ repeater in Sioux City, Iowa. ■

References

[1] Signetics Linear Data Book, 1972, page 177.

[2] Joseph M. Steim WA1OMS, "IC Repeater Logic System," *73*, Sept. 1973, page 27.

[3] G. Allen W2FPP, R. Sobus K2QLE, "Repeater Control with Simple Timers," *Ham Radio*, Sept., 1972, page 46.

[4] Clifford Klinert WB6BIH, "Repeater Keying Line Control," *73*, Feb. 1973, page 60.

Parts List

Q1 – Radio Shack 276-112 N-Channel JFET
Q2 – HEP 52
Q3, Q5 – HEP 726
Q4, Q7, Q11 – HEP 719
Q6, Q8, Q9, Q10 – HEP 736
D1-D5 – small signal germanium diodes
IC1 – SN7400 Quad NAND gate
IC2-IC5 – NE555 Timer IC
LED1 – yellow light emitting diode
LED2 – green light emitting diode
LED3 – red light emitting diode
All .01 uF caps are 25 volt disc ceramics
All fixed resistors are ½ Watt, 10% tol., resistance as marked on schematic
SW1 – DPDT, center-off switch

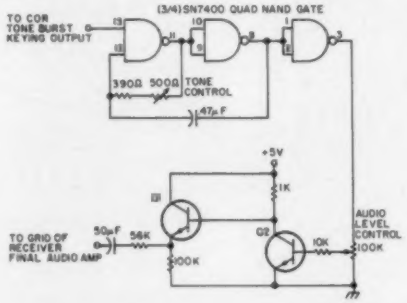

Fig. 15. A simple tone burst circuit that can be used with the digital COR. Q1 and Q2 can be any small-signal NPN transistors.

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EDITORIAL BY WAYNE GREEN

from page 4

in very small type so as to get the most material I could on each page. Older readers can be thankful that I, too, have one foot in the grave.

Eventually I managed to put my foot down (the other foot) and get things going the way I wanted them ... some day I'll tell you the inside story of how I managed to lose BYTE and all that mess ... suffice it to say the motto I have above my desk applies very well to me ... "Intelligence is no impediment to stupidity." Anyway, we will be running four columns in *73* most of the time for a while. There will be a few three column articles, using up type already set. See how you like it ... compare it, if you get a chance, with the layouts in *CQ* ... if you can find a copy anywhere. They are using giant type, two columns, apparently because they have too little material to fill their pages. In this way they seem to have merely enlarged the old two column pages to the new size. *Ham Radio* has done about the same ... very large type, lots of blank white page ... so it takes very little material to fill the magazine. It does give it a nice uncluttered look ... perhaps you prefer it.

QST uses the standard three column format, which was no surprise.

In time we should settle down in *73*. We'll use four columns and see how we and you like it. We'll try to get our diagrams settled down in size and go for nice big and clear photographs.

Several readers seem to have accepted the idea that the larger magazine is in some way magically less expensive than the smaller one. It sure would be nice if this were true, but it is just another myth. The monthly cost of printing *73* varies with the size of the magazine, and that varies with the number of ads ... the more ads the more articles you get ... remember that, if you happen to work for a ham manufacturer, ham dealer, or computer firm ... or if you have any dealings with any such. At any rate, after four issues at the new size I can tell you that the cost of putting out *73* has gone from around $25,000 a month to around $40,000, just as I said it would. Now who do you think is going to have to pay that extra money? You know darned well ... it will come out of your pocket one way or another ... some in increased subscription rates, some in increased prices on ham gear. Hopefully you are enjoying the new big size enough not to care about the few extra bucks. If you add in the additional postage costs it isn't all that few bucks. The tab comes to perhaps $250,000 extra a year in printing costs and postage. That's $2.50 each for 100,000 readers! Enjoy ... enjoy.

PROCESSING OSCAR

Here's a picture of Franklin WB4BWK who, together with VE2BYG/3 ... now VE3SAT, made the first computer-to-computer QSO via Oscar 7 mode B on October 9th last. This came about on orbit 4101 using ASCII RTTY ... a ham radio first.

Franklin has now interfaced his Oscar station with Erskine College's PDP-11 minicomputer and he is looking for RTTY/ASCII contacts via Oscar 6 or 7, mode A or B.

PEACEMAKER?

A note from a reader out in Michigan grumbles that he has been warned that his newly installed pacemaker should not be exposed to rf ... like diathermy, microwave ovens, transmitters and such. I suspect that he has been over-cautioned ... those ovens are extraordinarily shielded and a well matched and grounded ham rig should have little detectable rf around. How about it all you experts, what is the story? Do pacemaker hams have to run QRP and eat in places without microwave ovens?

PAYING FOR REPEATERS

As more and more repeaters are put on the air, the question of who is going to pay for them gets stickier and stickier. It isn't all that difficult where there is a bonafide repeater club which is handling the situation ... having regular meetings, classes for newcomers, charging dues, putting out a newsletter, etc. ... but where an individual has set up a repeater and then tries to force the users to reimburse him for the expenses involved ... that's going to take some discussion.

Not a few complaints have been received by *73* over this problem. Typical is a user gripe about WR1ABN in South Walpole, Mass., just outside Boston. This 147.69-.09 repeater is using a public channel and thus keeping other repeaters from being able to use it ... and there are quite a few groups that would dearly love to get the channel. A recent letter from Mario K1UHU, the proprietor of the repeater, asked for contributions. A local amateur who supports two local repeater clubs with dues got this letter and, when he didn't send the demanded money, says he was asked by K1UHU to get off the repeater and stay off.

My own reaction to such a demand would be to get madder than hell. I know for a fact that several of the locals who have gotten this rude treatment did react as I would. Thus we have a really miserable situation ... amateur radio is supposed to be fun, yet we have UHU out there doing his darndest to louse it up for a lot of people ... including himself. He has come on a great way to get unending kerchunkers and unsolicited nasty comments, as many arrogant repeater owners have discovered.

How would you feel if you got hit with something like this? It isn't practical to pay money to every repeater in your area ... few can afford it. Does that mean that unless we pay someone off we can't use a repeater? With the serious shortage of repeater channels in most areas perhaps it is about time to ask the coordinators to assign the best channels to the free and open repeaters ... the next best to clubs with a relaxed user policy ... and what is left, if anything, to people who want to charge for use of their repeater ... and move them off to 220 or up when a legitimate group needs a pair.

Not wishing to be controversial about things, I'll say no more ... right now ... so no mention of Tony Baloney and his pirate group will be made ... tempting though it may be.

DEREGULATION AND CB

One of the biggest turnarounds in communications has been the enormous change in citizens band operations ... and the amateur reaction to this change. Just a couple years ago CB was a dirty word to most amateurs and they wouldn't be caught dead operating on eleven meters. Today tens of thousands of amateurs are getting with CB and joining in the fun there.

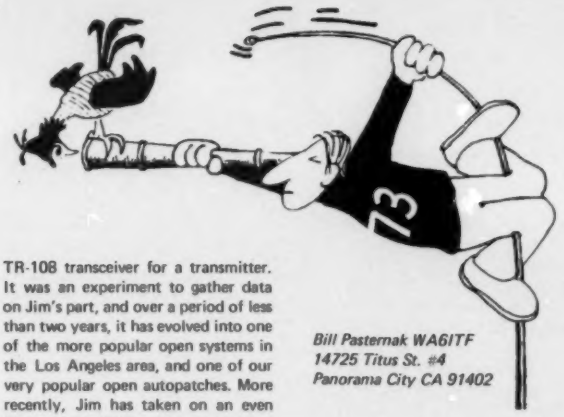
There has been a big change in CB due to the relaxation of the FCC rules permitting what had previously been illegal (virtually all of the CB communications), the present extreme low in sunspot activity and resultant lack of 11m skip, and the large influx of truck drivers spreading their friendly greetings to each other ... and to the little four wheelers getting in their way.

I remember just a little over a year ago when there was one other local amateur on CB ... Herman WA1MYS. Now I think a third of the local club members have a CB rig in their cars ... and the rest are getting edgy.

A couple years ago the few ham clubs which had tried to scout the CB ranks for ham prospects reported discouraging results. Now it appears that a good percentage of the ham club Novice classes are filled with CBers ... all anxious to move up to a ham ticket.

Continued on page 76

Looking West



Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Okay, you are not going to see the original manuscript of this column, but instead of being typewritten, it is being hand printed. Seems that my typewriter has "once more" developed the "flu," or in its case, some broken springs. A, S and V have gone to the "happy hunting ground" with B and F not far behind. Before the situation developed to the "point of no return," I felt it incumbent to take the necessary steps to remedy the situation, and now "Blue Boy" (the pet name of my typewriter, so awarded in honor of its particular color) is back at the manufacturer's service center getting a quick rebuilding. Hopefully, he will be back in service by this time next month; however, in the interim, it's back to the old way -- ball-point pen and lined paper. My goodness, it feels strange! Shades of PS-247.

How many of you know what happens when you send in that form 610 to renew your license? How many of you even know how a test is graded at the FCC office in Gettysburg PA? These were some of the points covered at the FCC Forum at SAROC '76. Representing the Commission was the chief himself, John B. Johnston K3BNS, head of the Amateur and Citizens Division. Now, I have been to a lot of talks given by a myriad of "officials," but I have never seen anyone as warmly received as Johnny. It is obvious that the amateur community likes this guy and, even more important, he likes us, and is willing to work with us to build a bright future for the amateur radio service and its members.

Through the use of color slides, John began his talk by taking us on a trip 2500 miles east to the city of Gettysburg PA. We met John's staff and learned how both amateur and citizens radio service licenses are processed, how STA's are issued, and many of the other intricate workings of his organization. In all, that part alone was quite an education, one that every amateur and CBer should be given. To say that Gettysburg is inundated with CB applications is the understatement of 1976! John's color slides and commentary explained the current problem with processing vs. time quite graphically. If we didn't understand or were unaware of their problem before, we sure understood it after this presentation.

Then John got into the meat of his dissertation: the future of the amateur service. He made it very clear that his intention was to deregulate wherever possible to enable amateurs to continue to experiment and develop new techniques and communications art forms. Wherever possible, we, the members of the amateur community, would be granted the necessary freedom to build toward a more viable amateur service, one designed to meet the needs of the future and one that would be as self-regulating as possible.

Since much of what he said has already been covered in *HR Report* and other publications, I will refrain from a long dissertation here. Suffice it to say that John is willing to work "hand in hand" with us to build a lasting future for amateur radio -- at least that's the way I read it. I think that the amount of deregulation in the past few months tends to bear out this feeling. Anyhow, if no one else has said it to date, I will. From all of us: "Thanks, John. We are proud to have you as one of us."

Now this leaves a few questions. Will we be able to handle the responsibility that deregulation places upon the shoulders of us all? Are we willing to bury our personal prejudices and begin to work "hand in hand" with one another toward the future? Are we mature enough to be truly self-directing? If each of us is willing to do his or her share, regardless of how insignificant that share might seem at the time, we can and will make deregulation a success and moreover prove the confidence that John has in us to be well founded. Deregulation is a challenge, but I think that we are ready to accept it. More on this topic, a lot more, in future months of "Looking West."

And I wrote, "Believe it or not WR6AJP is a full-time 24 hour-a-day open autopatch that operates on an inverted split-split and has never been down due to technical failure" or something along those lines. I think that the AJP repeater read my mind, for just about the time the story was published, it did "go down" due to a technical problem. However, to Jim Hendershot WA6VQP, its owner, the whole thing was just the necessary motivation needed to build the new system he had been planning. According to Jim's schedule, the "new improved WR6AJP" will be back in service within 3 weeks, and once again the San Fernando Valley will have its favorite autopatch.

AJP's story is a very interesting one, in that Jim never meant it to become the popular system that it is today. As he tells it, the whole thing began as a fun project using a Motorola HT as a receiver, a single tone surplus decoder, and a Knight TR-108 transceiver for a transmitter. It was an experiment to gather data on Jim's part, and over a period of less than two years, it has evolved into one of the more popular open systems in the Los Angeles area, and one of our very popular open autopatches. More recently, Jim has taken on an even bigger responsibility. He was asked to serve on the SCRA's Technical Committee for the '76 year by the SCRA's new chairman Bob Thornberg WB6JPI, and has been handed the challenge of developing a set of "standards" for amateur use of touchtone in autopatch service. If you have a number of autopatch systems that you frequent, you might well be aware that in many cases it requires different tone levels to activate the decoding equipment to access, control, and use a given repeater equipped with autopatch service, be it open or closed. The establishment of standards for this, along with other forward-looking ideas, seems to be the goal for this year's "SCRA."

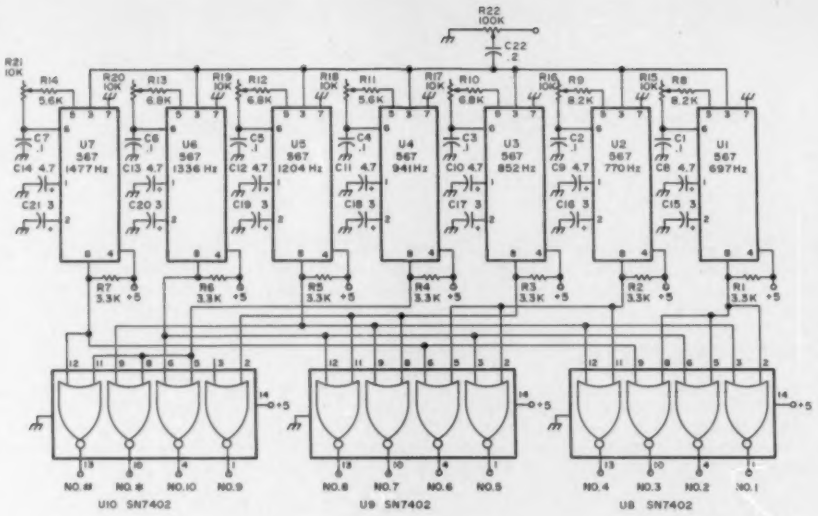
As mentioned earlier, Bob Thornberg WB6JPI has been elected the new "Mr. Chairperson" of SCRA, replacing Dick Flanagan W6OLD, who has retired after 3 hard years of service to that organization. The election of Bob to this post is interesting in that he is not only a repeater owner/delegate to SCRA, but he is also one of the most visible people involved in the Southern California FM scene. One might say that he not only represents the choice of the repeater owner, but the interests of the repeater user as well, for if the average repeater user were asked his or her choice as to who should be SCRA Chairman, the answer would probably be 'JPI.

Simply, Bob believes that people can solve their own problems, and is one of those rare individuals who possesses both technical expertise and common sense. Along with Burt K6OQK, he developed the inverted tertiary split plan fast becoming known as the "California Split Plan." He formed the first user support organization for an open repeater, the Mt. Wilson Repeater Association, a system of user support now being widely copied. He is one of the "good people" who is willing to listen to

Continued on page 134

John B. Johnston K3BNS, Chief of the Amateur and Citizens Division of the FCC, at the SAROC '76 FCC Forum.

Fig. 1. Basic tone decoder.



Warren MacDowell W2AOO
11080 Transit Road
East Amherst NY 14051

Touchtone Decoder

--using a calculator readout

With the advent of 2 meter FM and associated repeater systems, the "touch tone" system has found wide acceptance for both repeater control and dialing up autopatches. Probably the greatest reason for the touch tone system is the readily available touch tone pad, which is "ready made" and quite accurate in tone generation.

There are also a variety of touch tone decoding systems that have been devised. Most of these work well and generally control some major function of the repeater. When someone is dialing a function or placing a call with the autopatch system, I thought it would be nice to have a simple device that would read out the numbers dialed and retain them on a display until cleared manually.

The idea finally struck me that an el cheapo calculator would serve perfectly in this application. Just about any calculator can be used, yet retain its calculating ability while not serving as a memory. If you will observe the normal operation of a calculator, it progressively retains the digits entered on the keyboard. When the clear key is depressed, it erases this entry of numbers. Therefore if we were to parallel switches with the calculator keyboard switches and activate these switches with a touch tone decoder, the calculator would display the decoded digits until the calculator display range was exceeded or the clear key was depressed. Of course a 12 digit calculator is most desirable due to the number of digits it can retain in one display.

The first step is constructing a reliable tone decoder that is relatively insensitive to noise, etc. I have had very good results with the touch tone decoder described in the *National Linear Integrated Circuit Handbook*. This system uses the National LM567 which has high noise rejection, immunity to false signals and a very stable center frequency. The 567 Phased Locked Loop decoder was quite expensive ($9.00 each) until they sprang up on the surplus market. Radio Shack stores are now selling them for $3.50 each, which is not too bad. Seven of the 567s are required for the decoder and 3 SN7402 quadruple 2 input positive NOR gate ICs are used in the total decoder system. Fig. 1 illustrates the basic touch tone decoder. The complete decoder at present surplus prices can be constructed for about $30-$35.00.

The output (pin 8) of the 567 is normally "high" or at a potential of 5 volts. When a tone is decoded by the 567, the output goes low or nearly to ground potential. The desired frequency to be decoded is selected by the 10k potentiometer attached to pin 6. All of the 567s decoding as a group activate the proper 7402 gate and the output pin of the 7402 goes from a low to high state. This lends itself well for driving an NPN transistor which may switch whatever you desire.

If you want just an indicator lamp for each number that is decoded, an LED may be turned "on" by the NPN transistor with an appropriate current limiting resistor. I was fortunate enough to find a batch of 24 volt, 350 Ohm relays with four single pole contacts on each relay. At 24 volts, they required about 10-15

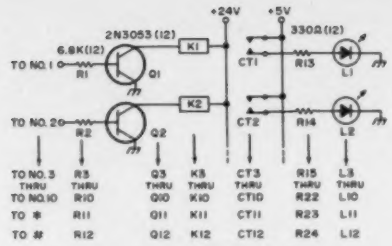


Fig. 2. Tone decoder drivers.

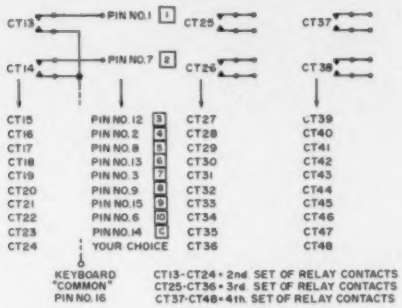

CT13
PIN NO. 1
1
CT25
CT37
CT14
PIN NO. 7
8
CT26
CT38
CT15 PIN NO. 12 3 CT27 CT39
CT16 PIN NO. 2 4 CT28 CT40
CT17 PIN NO. 8 5 CT29 CT41
CT18 PIN NO. 13 6 CT30 CT42
CT19 PIN NO. 3 7 CT31 CT43
CT20 PIN NO. 9 8 CT32 CT44
CT21 PIN NO. 15 9 CT33 CT45
CT22 PIN NO. 6 10 CT34 CT46
CT23 PIN NO. 14 C CT35 CT47
CT24 YOUR CHOICE CT36 CT48
KEYBOARD "COMMON" PIN NO. 16
CT13-CT24 = 2nd. SET OF RELAY CONTACTS
CT25-CT36 = 3rd. SET OF RELAY CONTACTS
CT37-CT48 = 4th. SET OF RELAY CONTACTS

Fig. 3. Decoder/calculator interconnections.

milliamperes for reliable closure of the relay. The 2N3053 NPN silicon transistors drove these relays nicely. No doubt you will be able to find surplus telephone type or military relays that will meet these requirements. If you don't go the surplus route, the relays may cost as much as $5.00 each. No doubt some of the surplus houses in *73* will be able to provide inexpensive relays. See Fig. 2 for the transistor relay driver system.

Each 567 tone decoder can be "tuned" by either the use of an audio signal generator or a touch tone pad. The desired tone frequency is fed into the separate 567s while metering pin 8 (output) of that decoder. A fairly high level of audio should be fed in at first and the 10k pot should be varied until the output drops to zero. This will indicate that you have arrived at the decoding frequency. Keep reducing the audio level and varying the pot in small increments until you find the lowest level at which the 567 will detect. This will be the most selective and sensitive position for the 567. This procedure should be continued throughout the remaining tone decoders.

If you do not have access to an audio generator, a touch tone pad may be used for alignment. (See Fig. 4.) By depressing the proper *pairs* or combinations of numbers on the touch tone pad, you can create the specific frequencies needed for alignment (this may not work on some newer pads). Follow the same procedure as that used with the audio generator. Should you have access to a frequency counter, it might be wise to test your particular touch tone pad to make sure it is on frequency. It might be especially "prudent" to do this if the pad was given to you or if you purchased it at a special sale price.

The first set of relay contacts on the 12 relays are used to activate LED readouts. The second set are in parallel with the calculator keyboard. The third and fourth sets are for anything you so desire. The main reason for using relays rather

Audio Frequency	Press These Touch Tone Pad Buttons Simultaneously
697 Hz	(1, 3) (1, 2)
770 Hz	(4, 5) (4, 6)
852 Hz	(7, 8) (7, 9)
941 Hz	(*, 0) (*, #)
1204 Hz	(1, 4) (1, 7) (1, *)
1336 Hz	(2, 5) (2, 8) (2, 0)
1477 Hz	(3, 6) (3, 9) (3, #)

Fig. 4. Pairs that may be pressed to generate single alignment tones.

than solid state devices is to compensate for the wide variety of calculators on the market. Some of these employ a positive ground and others, a negative ground system. Relays may be wired to either system without need for a PNP or NPN type of solid state switching device. Check out your particular keyboard as it may require a common bus to all switches or individual leads to all switches. If in doubt, wire all of the keyboard switches separately to the relay contacts. Only keyboard switches 1 to 0 will have to be wired to the relays. * and # relays could be used to clear or add the calculator in some clever setup.

Fig. 5 is the schematic and wiring system for the Western Electric touch tone pad. This is the configuration used for tuning up my decoder. The 500k pot is adjusted for desired output.

Fig. 6 is the regulated 5 volt power supply for the basic tone decoder. The relay power supply depends on the particular voltage relay you are able to obtain on the surplus market. With relays, the power supply filtering and regulation need not be critical. A simple bridge rectifier and filter capacitor should be adequate for the relays. Remember, however, that the dc output will be at least 1.4 times the ac voltage rating of the transformer with the bridge/filter capacitor supply.

This system provides an inexpensive touch tone memory that can be tailored to your requirements. The next time someone threatens to turn the repeater off through some "magic" combination of touch tone numbers, your "el cheapo" calculator will remember them. You take it from there — hi! ■

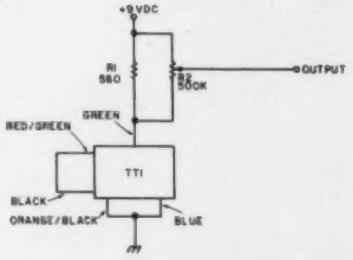


Fig. 5. Touch tone pad wiring.

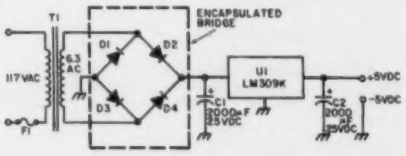
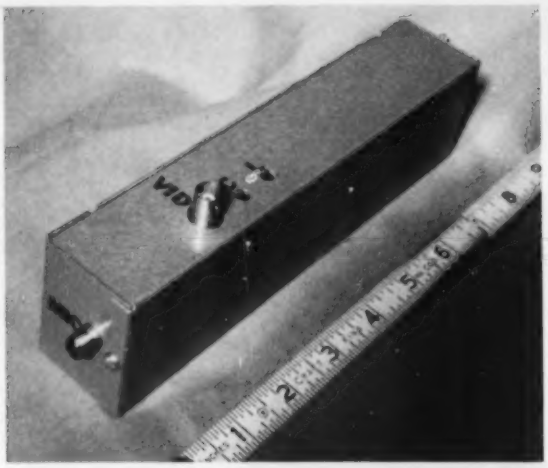


Fig. 6. Power supply.



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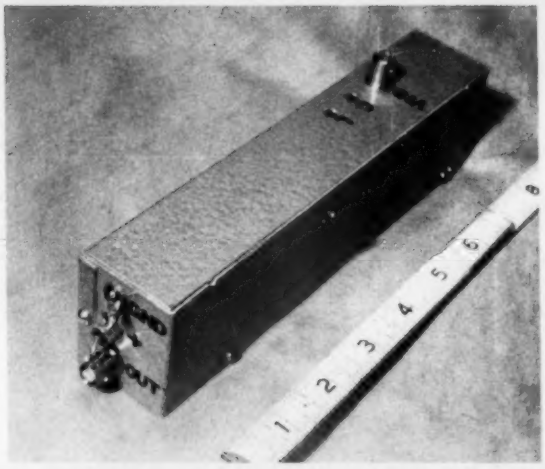
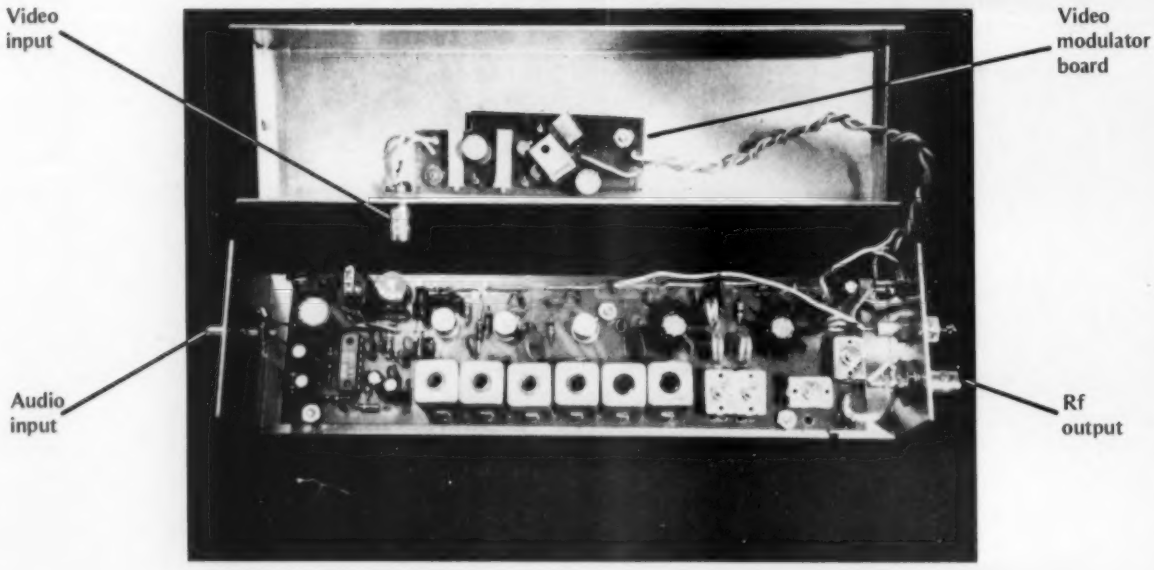


B

Bruce Brown WB4YTU/WA9GVK
4801 Kenmore Ave. #1022
Alexandria VA 22304

Simple Amateur TV Transmitter

-- at a QRP price



C

Fig. 1. 3/4 Watt ATV transmitter. (a) Mike input side; (b) output side; (c) internal view.

Smaller than a box of spaghetti and costing about $55 to build, this 3/4 Watt 3/4 meter ATV rig can simultaneously transmit AM video and FM audio on the video carrier. The unit is basically a VHF Engineering TX-432 transmitter, which is collector modulated using the HR-440 video modulator described in the Nov/Dec 75 *73* (pp. 42-43). Good linearity and excellent frequency response is achieved as shown in Fig. 2. Power drain is approximately 350 mA at 12 to 14 V dc.

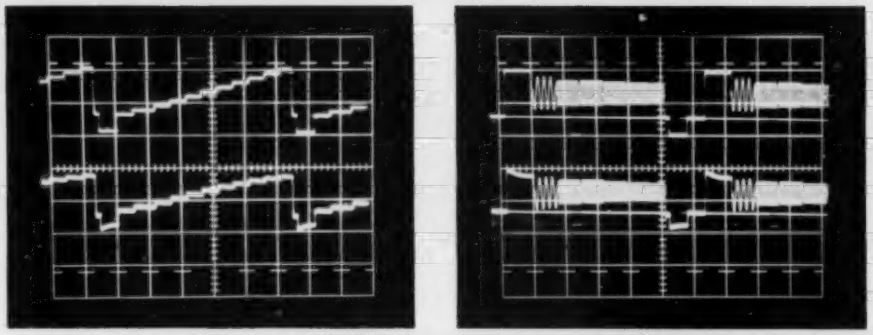


Fig. 2. Performance curves (all vertical scales uncalibrated). (a) Linearity: top scale, video in; bottom scale, detected rf output; 10 usec/div horizontal; 3/4 Watts out (ave.). (b) Frequency response: top scale, video in; bottom scale, detected rf output; 10 usec/div; 3/4 Watts out (ave.); burst order (in MHz) – 0.5, 1.5, 2.0, 3.0, 3.58, 4.2.

Applications

What can you do with a QRP ATV transmitter? Possible applications include:

1. Operating as a primary station rig, it can provide snow-free pictures over a 5 mile line-of-sight path between stations using 10 dBd gain antennas and 2.5 dB noise figure preamps. Better performance can be expected in areas where inversion layers are prevalent, such as Southern California. Especially effective operation results when used in conjunction with an ATV repeater. For example, W3API, located 3 miles from the WR4AAG TV repeater in Alexandria, Va., can send snow-free pictures to W3IRL who is 45 miles away in Baltimore.

2. The rig can be used as an exciter for a 1 Watt in, 10 Watt out linear amplifier such as the quasi-linear Motorola MHW-710 power module. (See Nov/Dec 75 *73*, p. 39, and Motorola MHW-710 data sheet #DS 5522 R2.)

3. It can be mounted inside a portable TV camera to create a self-contained hand-held station. If placed in a large R/C model airplane or rocket, such a system could provide some spectacular pictures.

4. It is ideal for general mobile applications (e.g., auto, aircraft) due to small size and power consumption.

5. Low power consumption also lends itself to solar-powered operation suitable for remote unmanned usage such as hidden transmitter hunts.

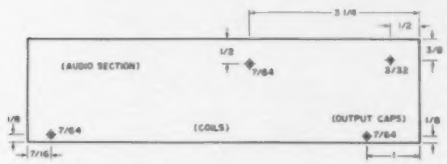


Fig. 3. TX-432 PC board drill guide. All dimensions in inches. Foil side down; component side up.

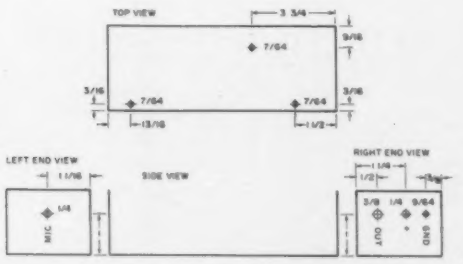


Fig. 4. TX-432 chassis drill guide. All dimensions in inches. All measurements from outside edge of chassis. Chassis is LMB #850. Guide not drawn to scale.

Modification Procedure

1. Drill holes in PC board and chassis using Figs. 3, 4 and 5 drill guides.

2. Construct, tune up and test TX-432 transmitter strip per manufacturer's instructions. Be careful that capacitors soldered to L1-L6 do not touch the coil cans. If necessary, insulate the inside surface of the cans with tape.

3. Locate coil L11. Unsolder the end connected to the +12 V dc line. Mount a miniature insulated terminal in the 3/32" hole provided by Step 1, above. Solder loose end of L11 to terminal (Fig. 6).

4. Mount all components to the video modulator PC board as described in the Nov/Dec 75 *73*, page 42, with the following exceptions:

a) R2 will be 100 Ohms.

b) Do not clip off tabs of D40 and D41 transistors. Instead, bend tabs down as shown in Fig. 1. Bend tab of D41 down and back onto itself to prevent the tab from protruding beyond the edge of the PC board.

5. Solder 6", #22 stranded wires to ground, +, and OUT on the video modulator board. Twist ground and + wires together. Solder 1" long wires to ground and IN at the other end of the board.

6. Solder 2½" length of RG-188 to the output of the transmitter board. The RG-188 shield length, soldered to ground of board, should be as short as possible.

7. Using 3/16" standoffs, #4 screws, lockwashers and nuts, mount the transmitter and modulator boards to the chassis.

8. Mount VID (video in) and OUT (rf output) BNCs to chassis. Also mount phono jack, feedthrough capacitor and two ground lugs using a #6 screw, lockwasher and nut. One lug is mounted inside the case; the other, outside.

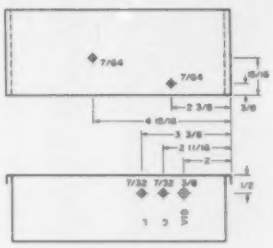
9. Solder shield and center conductor of the RG-188 from the transmitter strip to the OUT BNC. The shield should be soldered directly to the threads of the connector and should be as short as possible.

10. Solder a #22 insulated wire from the feedthrough capacitor to the +12 V dc line on the transmitter board. Solder the ground lug on the chassis to ground on the board. Solder wires from the phono jack to mike input and ground on the board.

11. Solder 1" input and ground wires from the video modulator board to the VID BNC. Solder twisted + and ground wires from the same board directly to the feedthrough cap and ground lug on the chassis, respectively. Solder the wire from OUT on the video modulator to the insulated terminal (one end of L11) on the transmitter board.

12. Apply stick-on lettering to the case as shown in Figs. 1, 4 and 5.

Fig. 5. TX-432 chassis cover drill guide. All dimensions in inches. All measurements from outside edge of chassis. Chassis is LMB #850. Guide not drawn to scale.



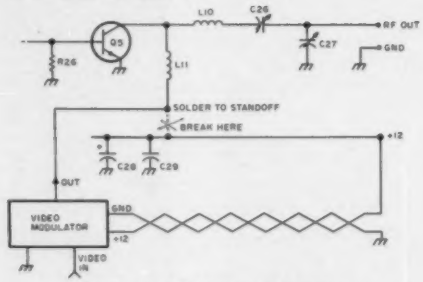


Fig. 6. Modification schematic.

(Tuneup)

13. Connect the output of the rig to a wattmeter with a dummy load or through-line wattmeter with an antenna. Turn "L" (level) control on video modulator fully clockwise and "C" (contrast) control fully counterclockwise. Connect a 12-14 V dc, ½ A regulated power supply to the + and GND terminals. Connect a composite 1 V P-P video signal to the VID connector. Monitor the rf output on a converted TV receiver.

14. Adjust C24, 25, 26 and 27 on the transmitter for maximum power output. Approximately 1 Watt should be obtainable. Alternately turn "L" counterclockwise and "C" clockwise for best picture on the TV receiver. You may have to readjust C24-27. Do not set the contrast too high or else sync buzzing will occur on the audio channel. (As described in the Nov/Dec 75 *73*, p. 40, a separate FM receiver is required to demodulate the audio.) During this tuneup procedure you will note that the "C" control affects only contrast while the "L" control will affect both output level and contrast. In general, the higher the output level, the lower the contrast. A good picture at 3/4 Watt will be possible.

Parts List

Part #	Description	Qty	Unit Cost	Total Cost	Source of Supply
1	8-1/2 x 2-1/8 x 1-5/8 Chassis; LMB #850	1		2.50	Electronic Supply
2	UG-1094 BNC Bulkhead Connector	2	.85	1.70	Electronic Supply
3	Phono jack Bulkhead Connector #274-346	1		.37	Radio Shack
4	.001 uF feedthrough cap; Erie 327-005-X5UO-102M	1		1.62	Electronic Supply
5	Subminiature 2-56 insulated terminal Cambion #601-1531 (15 per package @ $2.00)	1		.17	Electronic Supply
6	2-56 nut and lockwasher for standoff	1 ea			Hardware Store
7	1/2" 4-40 screws, lockwashers and nuts	5 ea			Hardware Store
8	3/16" long #4 spacer (2 nuts may be used for spacer)	5 ea			Hardware Store
9	1/2" 6-32 screw, lockwasher, washer & nut	1 ea			Hardware Store
10	#6 hole terminal lug (ground lug)	2			Hardware Store
11	#22 stranded wire	36"			Electronic Supply
12	Stick-on lettering kit				Stationery Store
13	Video modulator PC board; etched, cut and drilled with RG-188 cable	1		3.00	Stu Mitchell WAØDYJ 14761 Dodson Woodbridge VA 22193
	Video modulator board parts:				
D1	1N4001 Diode	1		.20	James Electronics
R1	100 Ohm pot, #43P101 Spectrol	1		1.35	P.O. Box 822
R2	100 Ohm, 1/4 Watt, 10%	1		.05	Belmont CA 94002
R3	5k Ohm pot, #43P502 Spectrol	1		1.35	(415) 592-8097
R4	1.0k Ohm, 1/4 Watt, 10%	1		.05	Add 5% for postage
R5	82 Ohm, 1/4 Watt, 10%	1		.05	$5.00 min order
R6	4.7k Ohm, 1/4 Watt, 10%	1		.05	
R7	10k Ohm, 1/4 Watt, 10%	1		.05	
C1, 2	100 uF, 16 V dc Radial	2	.19	.38	
Q1, 2	2N2222A	2	.20	.40	
Q3	D40D7 (GE)	1		2.35	Spectronics
Q4	D41D7 (GE)	1		(both) Ppd	1009 Garfield St. Oak Park IL 60304

TX-432 Transmitter kit is available from VHF Engineering for $39.95 (PO Box 1921-7, Binghamton NY 13902).

Required Tuneup Tools

1. 0.075" plastic hex alignment tool (GC #9304; $0.55)
2. Phenolic screwdriver

Notes:
1. A 0.5 Amp regulated 12 to 14 volt power source is required.
2. The crystal is a commercial standard, 20 pF in an HC-25 package. Frequency is desired rf frequency divided by 24.

Acknowledgements

I am grateful to Charles Spitz W4API, for providing the TX-432 transmitter strip and other needed components. Terry Fox WB4JFI provided valuable suggestions and test equipment used for optimization of the modification design procedure. ■

When you get tired of compromises...

TS-700A Specifications

TRANSMIT/RECEIVE FREQUENCY RANGE: 144-148 MHz
MODE: SSB, FM, CW, AM
RF OUTPUT: CW, FM: more than 10W output. AM: more than 3W output. SSB: more than 20W DC input.
ANTENNA IMPEDANCE: 50Ω (unbalanced)
CARRIER SUPPRESSION: Better than 40 dB
SIDE-BAND SUPPRESSION: Better than 40 dB
SPURIOUS RADIATION: Less than −60 db

MAX. FREQUENCY DEVIATION (FM): ±5 kHz
REPEATER FREQUENCY SHIFT WIDTH: 600 kHz
TONE BURST TIME: 0.5-1.0 sec.
MODULATION: Balanced modulation for SSB. Variable reactance frequency shift for FM. Low power modulation for AM.
MICROPHONE: Dynamic microphone, 500Ω
AUDIO FREQUENCY RESPONSE: 400-2600 Hz, within −9 db
RECEIVING SYSTEM: SSB, CW, AM: Single-superheterodyne. FM: Double-superheterodyne.
INTERMEDIATE FREQUENCY: SSB, CW, AM: 10.7 MHz. FM: 1st IF: ... 10.7 MHz. 2nd IF: ... 455 kHz.
RECEIVING SENSITIVITY: SSB, CW: S/N = 10 dB or better at 0.25μV. 20 dB noise quieting = Less than 0.4μV. AM: S/N = 10 dB or better at 1μV.
IMAGE RATIO: Better than 60 dB
IF REJECTION: Better than 60dB
PASS-BANDWIDTH: SSB, CW, AM: More than 2.4 kHz at −6 dB. FM: More than 12 kHz at −6 dB.
RECEIVER SELECTIVITY: SSB, CW, AM: Less than 4.8 kHz at −60 dB. FM: Less than 24 kHz at −60 dB.
SQUELCH SENSITIVITY: 0.25μV
AUDIO OUTPUT: More than 2W at 8Ω load (10% distortion)
RECEIVER LOAD IMPEDANCE: 8Ω
FREQUENCY STABILITY: Within ±2 kHz during one hour after one minute of warm-up, and within 150 Hz during any 30 minute period thereafter.
POWER CONSUMPTION: Transmit mode: 95W (AC 120/220V), 4A (DC 13.8V), max. Receive mode (no signal): 45W (AC 120/220V), 0.8A (DC 13.8V).
POWER REQUIREMENTS: AC 120/220V, 50/60 Hz, DC 12-16V (13.8V as reference).
DIMENSIONS: 278 (W) x 124 (H) x 320 (D) mm
WEIGHT: 11 kg
SUGGESTED PRICE: $700.00

Prices subject to change without notice

KENWOOD'S TS-700A finally fulfills the promise of 2-meters...more channels, more versatility, tunable VFO, SSB-CW and, best of all, the type of quality that has placed the Kenwood name out front.

- Operates all modes: SSB (upper & lower), FM, AM, and CW
- Completely solid state circuitry provides stable, long lasting, trouble-free operation
- AC and DC capability. Can operate from your car, boat, or as a base station through its built-in power supply
- 4 MHz band coverage (144 to 148 MHz) instead of the usual 2
- Automatically switches transmit frequency 600 KHz for repeater operation. Just dial in your receive frequency and the radio does the rest... Simplex repeater reverse
- Or do the same thing by plugging a single crystal into one of the 11 crystal positions for your favorite channel
- Outstanding frequency stability provided through the use of FET-VFO
- Zero center discriminator meter
- Transmit/Receive cabability on 44 channels with 11 crystals
- Complete with microphone and built-in speaker
- The TS-700A has been thoroughly field-tested. Thousands of units are in operation throughout Japan and Europe

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Hy-Gain 272
2-meter antenna
The first truly portable repeater.

At last! A high performance, 2-meter antenna that combines state-of-the-art electronics, corrosion-free fiberglass and take-apart design for true portable use.

The Hy-Gain 272 is an entirely self-supporting 21' omnidirectional antenna system that separates into three pieces for transport. It consists of 4 stacked 5/8 wave radiators with three 1/2 wave phasing coils and a 1/4 wave decoupling system.

Each section length is specifically computed to completely eliminate end-feed pattern tilt, keeping radiation angle flat and close to the ground for maximum efficiency.

The 272 is ideal for portable repeater, repeater, and home use. Take it with you, wherever you go. Mounts easily on any 1-1/4" to 1-1/2" masts and it's factory tuned, to eliminate re-tuning in the field. Recessed coax connector, mounting bracket and hardware included.

Get the first truly portable repeater antenna. Only from Hy-Gain.

Power	250 watts
VSWR at resonance	Less than 1.5:1
Input impedance	50 ohms

Produces 6 dB gain over 1/2 wave dipole

hy-gain®

Hy-Gain Electronics Corporation, 8601 Northeast Highway Six; Lincoln, NE 68505; 402/464-9151; Telex 48-6424
Branch Office and Warehouse: 6100 Sepulveda Blvd., #322; Van Nuys, CA 91401; 213/785-4532; Telex 65-1359
Distributed in Canada by Lectron Radio Sales, Ltd.; 211 Hunter Street West; Peterborough, Ontario

Bruce J. Brown WB4YTU/WA9GVK
4801 Kenmore Ave., Apt. 1022
Alexandria VA 22304

Amateur TV Receiving System

--some of what you wanted to know

Because of practical and regulatory considerations, amateur television (ATV) transmitted power levels must be considerably lower than those radiated by commercial broadcast stations. To attain reasonably long operating ranges, the ATV receiver must compensate for what the transmitter cannot do. Thus, it must exhibit a considerably greater sensitivity than that required for broadcast reception.

An increase of only 3 dB in receiver sensitivity can make a noticeable improvement in picture quality. It is therefore important to squeeze every last dB out of a receiver system – and getting those extra dB at 440 MHz is far more difficult than on the lower frequency bands. Nevertheless, through proper component selection, a high performance and reasonably priced receiver is a reality.

Throughout the past two years, the Metrovision Amateur Television Club of Greater Washington D.C. has been examining numerous components and configurations in an effort to engineer an ATV receiving system with the following characteristics:

1. Excellent sensitivity.
2. Reasonably low cost.
3. As many off-the-shelf and readily available components as possible.

These design goals were established at the outset with one overall consideration in mind – that is, to make it as easy as possible for people to receive ATV.

Based upon these goals and after considerable testing, such a system has been developed and has proven to be successful. Fig. 1 shows the configuration and Table 1 lists recommended components, costs and sources of supply. Specific brands are stated in lieu of providing only generic names. This is necessary since performance varies greatly from product to product. For example, a Radio Shack UHF-to-VHF converter, which performs well for commercial broadcast reception, is a bummer for ATV work. It should be emphasized that the Metrovision ATV Club is a nonprofit group and has no financial ties to any of the companies mentioned. The recommendations are totally objective and based upon 2 years of comprehensive on-the-air tests. Furthermore, the equipment recommendations pertain only to optimal reception of wideband TV signals in the 3/4 meter band and may not necessarily be the components desired for receiving other signals such as narrowband FM or moonbounce.

In addition to providing a picture, this configuration will allow audio to be heard on the TV receiver only when the receive signal employs 4.5 MHz subcarrier audio (FM audio located 4.5 MHz above the video carrier). Incidentally, this is the output format used by an ATV repeater. When operating simplex and receiving a signal using an audio-on-the-video carrier format, a separate FM receiver must be used to pick up the audio. Low cost receivers for this purpose include the VHF Engineering RX432C kit ($79.95) or surplus Motorola UHF Pocket Pager (under $40). The antenna of these receivers could be a short piece of wire wrapped around the preamp output cable to provide signal coupling from the large antenna.

Keep in mind that your investment in good transmission line and an antenna is doubly worthwhile since these components will also be used when you're ready to transmit ATV. Try to get your antenna up as high as possible and away from nearby obstructions including trees. When conditions are right, don't be surprised if you get some good ATV DX!

ADDENDUM
Blonder-Tongue UHF-to-VHF Converter Modification

A modified commercial UHF-to-VHF converter connected to the antenna terminals of a standard home TV tuned to an unused channel between 2 and 6 is the simplest and most effective means for receiving a fast scan amateur video signal. The lowest frequency normally tuned by a converter is about 460 MHz; therefore, modification is required to enable the converter to tune

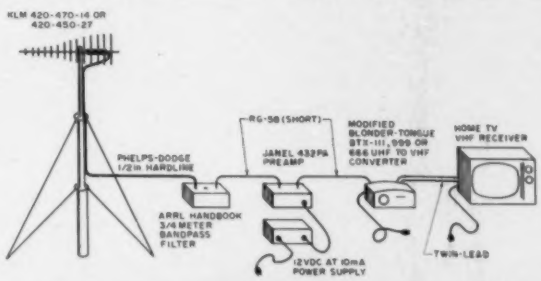

Fig. 1. Recommended ATV Receive Configuration.

Description	1975 Cost (Subject to change)	Source of Supply
I. Antenna		
KLM 420-470-14, 5 feet, 4 lbs, 13.7 dB iso gain	$21.95 + postage	KLM
—or—		17025 Laurel Rd.
KLM 420-450-27, 10 feet, 7.5 lbs, 16.7 dB iso gain	$39.95 + postage	Morgan Hill CA 95037
With either antenna, use balun: KLM 1:1 Balun	$13.95 + postage	(408) 779-7363
Notes: 1. Use correct antenna polarization for your area. 2. Mount antenna high enough to clear nearby obstructions including trees. 3. 2 antennas may be stacked together for additional 3 dB gain.		
II. Transmission Line		
FX 12-50H, 50 Ohm, ½ inch outer conductor, insulated, min. bending radius = 5", approx. 1.9 dB loss per 100 feet at 440 MHz.	$ .68/foot	Phelps-Dodge Corp. Route 79 Marlboro NJ 07746
Connectors for above cable		(201) 462-1880
a. N female, #20-654	$ 6.50	
b. N male, #22-654	$ 8.50	
c. UHF female, #66-654	$ 6.50	
d. UHF male, #68-654	$ 5.50	
—or—		
FXCC12-50H same as above but corrugated outer conductor; considerably more flexible and easier to work with.	$ .90/foot	
Connectors for above cable		
a. N female, #20-500	$ 8.25	
b. N male, #22-500	$ 8.25	
c. UHF female, #66-500	$ 8.50	
d. UHF male, #68-500	$ 7.00	
Note: RG-8 cable can be used for runs up to 50 feet. Measured loss ≅ 3 dB/50 feet (2 dB worse than hardline).		

down into the 420-450 MHz amateur band.

Considering sensitivity, stability, and cost, the best converters for amateur use are the Blonder-Tongue BTX-111, 999 and 666. All of these units can be modified using the same procedure as follows (see Fig. 2):

1. Remove six screws from back and pull off channel knob from front.
2. Spreading out top and bottom of plastic case, push out chassis by applying pressure through rear rectangular opening.
3. Locate C1 on top of chassis (see Fig. 3). Gently turn clockwise as far as it will go. You have now changed the tunable frequency of the unit down into the amateur band.
4. From underside of the chassis locate L1 (see Fig. 4). It is a semicircular strip of metal located in the center of three sections along the main tuning control axis. Locate the point where L1 connects to L2. (L2 is two short parallel wires running between the center and rear sections.) Solder a 2-8 pF subminiature variable capacitor (e.g., Erie ceramic) in electrical parallel with L1 — one lead of the cap connected to the L1-L2 junction point and the other

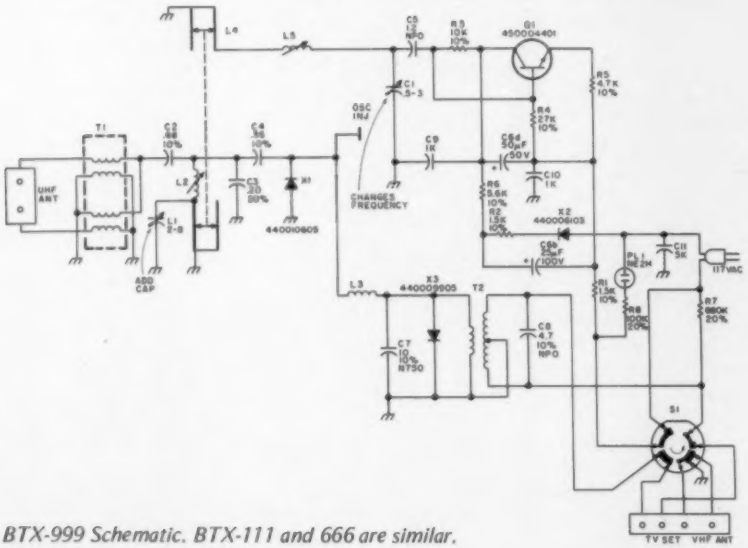

Fig. 2. BTX-999 Schematic. BTX-111 and 666 are similar.

III. Tunable 3/4 meter bandpass filter; Construction details in ARRL *Amateur Radio Handbook* or VHF manual Note: Filter greatly improves receive picture quality through reduction of out-of-band noise including commercial 450-470 MHz service and UHF broadcast TV signals.	About $5.00	Local electronics dist. and hardware store
IV. Preamp; Janel #432PA, comes fully built in chassis with BNC connectors. Requires 12 V dc @ 10 mA filtered power supply (e.g., Lafayette #99F50742, $10.95)	$33.00 postpaid	Janel Labs 260 N.W. Polk Ave. Corvallis OR 97330 (503) 757-1134
V. Modified UHF-to-VHF converter, Blonder-Tongue. Any of the following will work: a. BTX-666 b. BTX-999 (Same as 666 but has fine tuning control and channel light) c. BTX-111 (Same as 999 but has post amp, exhibits slightly better performance than other two if preamp is not used. If preamp is used, as is the case 95% of the time, all give equal performance.) Notes: 1. See Addendum for modification procedure which is identical for all units. 2. Make sure converter has a brown case. Earlier versions which were unstable used ivory cases.	 $20.00 approximately $23.90 $33.70	Lafayette Radio 111 Jericho Turnpike Syosset, L.I., NY 11791 (516) 921-7500 Stocks only BTX-111 (18F18319)
VI. Unmodified Home TV Receiver Notes: 1. Connect output of converter to VHF antenna terminals on TV set. 2. Turn channel selector to any unused channel between 2 and 6.		

Table 1. ATV Receive Configuration Component List.

lead to ground (wall between center and rear sections). Position the capacitor to permit easy access for adjustment.

5. Drill ½" hole in the bottom of plastic case to allow access to the capacitor after the unit has been "buttoned up."

6. Place the chassis back in the case along with the six screws in the rear and the knob in the front.

7. Connect the antenna transmission line (from the T/R relay or preamp) to the UHF ANT terminals of the converter. Connect 300 Ohm twinline between the converter's TV set terminals and the VHF antenna terminals of your TV receiver. Connect your existing commercial broadcast antenna to the VHF ANT terminals on the converter.

8. Tune your TV set to an unused channel between 3 and 6. Place converter front panel switch in UHF position. In general, the amateur band will be found between channel positions 14 and 20. Using a non-metallic screwdriver, adjust the capacitor for best picture. It need only be adjusted once. ■

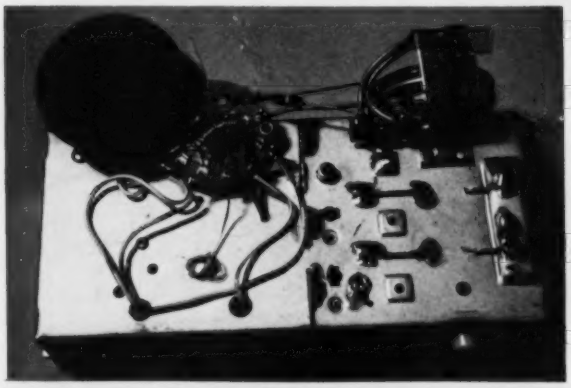

Fig. 3.

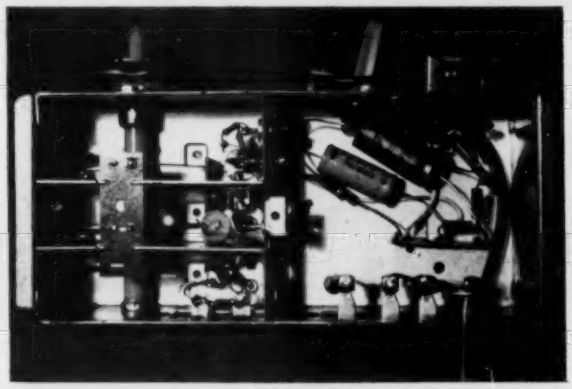

Fig. 4.

Wilson Electronics Corp.

FACTORY DIRECT ONLY

SUMMER SPECIAL

1402SM
HAND HELD
2.5 WATT
TRANSCEIVER
144-148 MHz
$164.95

1405SM
HAND HELD
5 WATT
TRANSCEIVER
144-148 MHz
$239.95

Shown With Optional Touch-Tone Pad

FEATURES

1402 SM

- 6 Channel Operation
- Individual Trimmers on all TX/RX Crystals
- All Crystals Plug In
- 12 KHz Ceramic Filter
- 10.7 IF and 455 KC IF
- .3 Microvolt Sensitivity for 20 dB Quieting
- Weight: 1 lb. 14 oz. less Battery
- S-Meter/Battery Indicator
- Size: 8 7/8 x 1 7/8 x 2 7/8
- 2.5 Watts Minimum Output @ 12 VDC
- Current Drain RX 14 MA TX 500 MA
- Microswitch Mike Button
- High Impact Plastic Case

1405 SM

- 6 Channel Operation
- Individual Trimmers on all TX/RX Crystals
- All Crystals Plug In
- 12 KHz Ceramic Filter
- 10.7 and 455 KC IF
- .3 Microvolt Sensitivity for 20 dB Quieting
- Weight: 1 lb. 14 oz. less Battery
- Battery Indicator
- Size: 8 7/8 x 1 3/4 x 2 7/8
- Switchable 1 & 5 Watts Minimum Output @ 12 VDC
- Current Drain: RX 14 MA TX 400 MA (lw) 900 MA (5W)
- Microswitch Mike Button
- Unbreakable Lexan® Case

SPECIAL ON EACH RADIO INCLUDES:

Flex Antenna
52/52
Simplex Xtal

Can be Modified for MARS or CAP

10 Day Money Back Guarantee

90 Day Warranty

TO: WILSON ELECTRONICS CORP., 4288 S. POLARIS AVE., LAS VEGAS, NEVADA 89103, (702) 739-1931

SUMMER SPECIAL DIRECT SALE ORDER BLANK

___ 1402SM @ $164.95
___ 1405SM @ $239.95
___ WE224 @ $199.95
___ 2202SM @ $239.95
___ 4502SM @ $279.95
___ BC1 @ $34.95
___ BP1 @ $14.95
___ BT1 @ $6.00
___ LC1 @ $9.95
___ LC2 @ $9.95
___ SM1 @ $24.95
___ SM2 @ $24.95
___ TE1 @ $34.95
(SPECIFY FREQUENCY _____)

___ TTP @ $49.95
___ XF1 @ $9.95
___ TX or RX XTALS @ $3.75 ea.
___ FACTORY XTAL INSTALLATION/ NETTING @ $7.50/Radio

EQUIP TRANSCEIVER AS FOLLOWS:

	XTALS TX	RX		XTALS TX	RX
A.	52	52	G.		
B.			H.		
C.			I.		
D.			J.		
E.			K.		
F.			L.		

ENCLOSED IS _____ ☐CHECK ☐MONEY ORDER ☐MC ☐BAC

CARD # _____

EXPIRATION DATE _____

NAME _____

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CITY _____

STATE _____ ZIP _____

SIGNATURE _____

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WILSON "WE-224" MOBILE

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$199.95

90 Day Warranty

10 Day Money Back Guarantee

FEATURES

1. 24 Channel Operation
2. One priority Channel
3. Selectable 1 or 10 Watts Out
4. 10.7 Monolithic Filter Installed
5. 455 KHz Ceramic Filter
6. .3 Microvolt Sensitivity for 20 dB Quieting
7. Numerical Read-out on each Channel
8. Built-in Adjustable "Tone Burst" Generator
9. Front Panel "Tone Burst" Control
10. Accepts Wilson 1402 & 1405SM Xtals
11. Individual Trimmer Capacitors for both TX/RX
12. Mosfet Front End
13. Helical Resonator
14. High VSWR Protection Circuit
15. Reverse Polarity Protection Circuit
16. NBFM - 15 KHz Channel Separation
17. Built-in Speaker
18. External Speaker Jack
19. Dynamic Microphone Included
20. Mobile Mounting Bracket Included
21. Quick Disconnect Power Cable
22. Frequency Range 144-148 MHz
23. 6½"W x 2½"H x 9½"D
24. Weight: 5½ lbs.
25. Power Requirements:
    - Source: 13.5 VDC ± 10%
    - Receive: .45A
    - Transmit: 2.6A (10W), .7A (1W)

SPECIAL INCLUDES:

A. WILSON "WE-224"
B. MOBILE MIKE
C. MOUNTING BRACKET
D. 146.52/52 SIMPLEX CRYSTALS

SUMMER SPECIAL on Wilson Hand Held 220 and 450

2202 SM

FREQUENCY RANGE 220 - 225 MHz

- 6 Channel Operation
- Individual Trimmers on all TX/RX Crystals
- All Crystals Plug in
- 12 KHz Ceramic Filter
- 10.7 and 455 KC IF
- .3 Microvolt Sensitivity for 20 dB Quieting
- Weight: 1 lb. 14 oz. less Battery
- Battery Indicator
- Size: 8 7/8 x 1 3/4 x 2 7/8
- Switchable 1 & 2.5 Watts Output @ 12 VDC
- Current Drain: RX 14 MA, TX 500 MA
- Microswitch Mike Button
- Unbreakable Lexan® Case

USES SAME ACCESSORIES AS 1405

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$239.95

INCLUDES

1. 2202 SM
2. Flex Antenna
3. 223.50 Simplex Installed

4502 SM

FREQUENCY RANGE 420 - 450 MHz

- 6 Channel Operation
- Individual Trimmers on all TX/RX Crystals
- All Crystals Plug in
- 12 KHz Ceramic Filter
- 21.4 and 455 KC IF
- .3 Microvolt Sensitivity for 20 dB Quieting
- Weight: 1 lb. 14 oz. less Battery
- Battery Indicator
- Size: 8 7/8 x 1 3/4 x 2 7/8
- Switchable 1 & 1.8 Watts Output @ 12 VDC
- Current Drain: RX 14 MA, TX 500 MA
- Microswitch Mike Button
- Unbreakable Lexan® Case

USES SAME ACCESSORIES AS 1405

SUMMER SPECIAL

$279.95

INCLUDES

1. 4502 SM
2. Flex Antenna
3. 446.00 Simplex Installed

ACCESSORY SPECIALS

DESCRIPTION		SPECIAL PRICE
BC1	BATTERY CHARGER	$34.95
BP1	10 EA. AA GOULD NICAD BATTERIES	14.95
BT1	EXTRA BATTERY TRAY	6.00
LC1	LEATHER CASE 1402	9.95
LC2	LEATHER CASE 1405, 2202, 4502	9.95
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SM2	SPEAKER MIKE FOR ALL NEW HAND HELDS WITH ROUND 6 PIN CONNECTOR	24.95
TE-1	SUB-AUDIBLE TONE ENCODER INSTALLED	34.95
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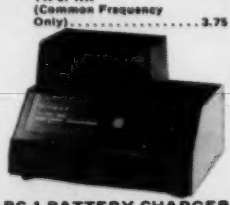


BC-1 BATTERY CHARGER

J. K. Bach
Ivy Hill Road
Walden NY 12586

Glass Arm

--the dreaded CW man's disease

This is the age of the Natterer. SSB, FM via repeater, Teletype, slow scan. And a little bit of Hand Modulation, mostly confined to Novices and old men.

Nearly all the old men use an electronic keyer of some sort, usually a very complex sort. A very few use the mechanical Vibroplex. None use a hand key, so far as I know. Only Novices use them, and in most cases, pretty badly. This is a pity, for the fluent use of a hand key is less a skill than a knack. In any case, the art has long since been lost.

There are any number of books that tell you how to hold and operate a hand key. Every book on learning code does, whether it's the Army Training Manual or those produced by various magazine and book publishers. They tell you everything but how to send, as long as you like, without acquiring Telegrapher's Paralysis, or "Glass Arm." Either they never heard of it, or think it wiser to leave the question alone. While very few of us use keys much, it *is* nevertheless a very useful and important skill.

The QRPP boys climb mountains with their two pound CW transceivers – besides VFO-buffer, FET, four transistors and an IC, the thing has to have a solid state keyer which is even more complex than the unit it serves. How nice if a small mechanical key – homemade – were mounted on the clipboard used for copying. Or even one of those Japanese dollar keys that have been kicking around for the last twenty years. Compared with the "good" solid brass telegraph keys, they never induce a "Glass Arm" – while the "good" ones will. So, the Japanese ones not only save money, weight, battery power and bulk, but they also save arms and improve sending, too.

It helps in your FCC examination if you can send properly. Only one in ten, or so, fail because of sending, but even that is too much. The straight keys are mounted on each desk where candidates sit. They are easily adjustable, and are usually left in some weird setting, such as with a half inch contact spacing.

The receiving exam eliminates many of the applicants, so that the examiner has only a few to watch, as he prepares to listen to each one. As each hopeful adjusts the key to his liking, the examiner makes bets with himself about who will fail and who will pass. He gives each applicant a paragraph out of a manual to send.

It is easy to tell if you passed. The examiner does not congratulate you and shake your hand; he listens to your four or five Vs and the first two or three words, and says, "That's enough." You'd like to finish the paragraph but he won't let you. From the first two or three words he knows that you could send for fifteen minutes without a mistake if allowed. He knows telegraphers; he's one himself. If he lets you send two sentences, you may scrape by. Half a paragraph only if he thinks he can find therein some excuse to pass you.

Receiving, of course, is an entirely different matter, requiring different skills. It is very definitely harder, as any ham knows.

In sending, there are two schools of thought about the management of elbows: on the table and off the table. If you embrace both, the key must be mounted on a board with a non-skid surface, so that it may easily be moved as required.

A hand key requires complete control. The hand must be easy and relaxed, but still in full control of everything the key-lever does. Do not depend on the return-spring; its function is to keep the key open when idle.

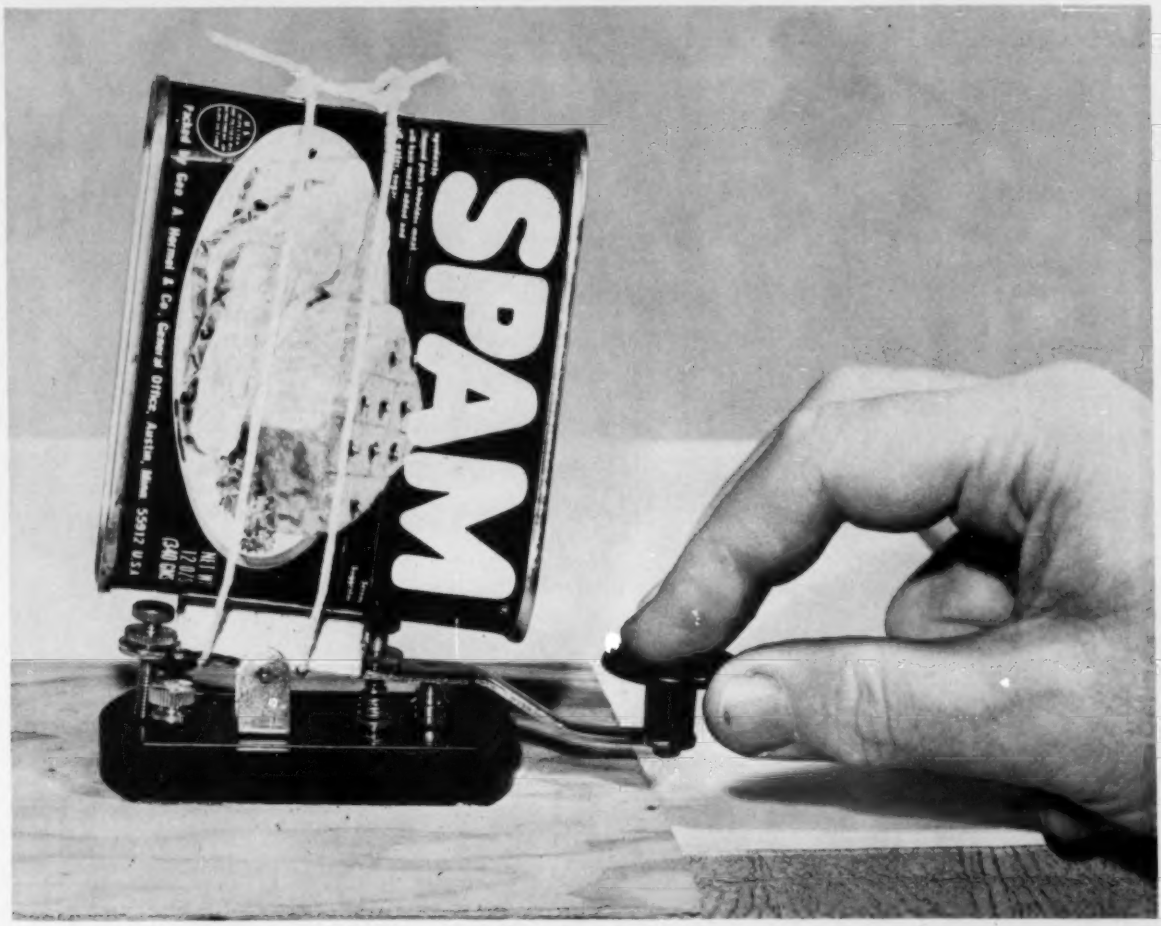
For your first practice session (of *course* you have to practice, but not for long) the key return-spring should be removed entirely. Put the spring in a glass jar so it doesn't get lost.

Now, in order to send, you have to "pump" the key-button up and down, holding it between forefinger and thumb. It is just as important to lift up as to press down.

A very good exercise is a long, slow series of dots. It is even better to time this by saying aloud: "Dot, uh, dot, uh, dot, uh," making the mark (dot) and space (uh) as nearly the same length as you can. When you get into the rhythm of it, it's easy. But don't speed up.

Silly as it sounds, this exercise will do a lot for you. Do it only until you begin to get tired of it, then quit, put the spring back in and send normally for a while. Don't push it. Next day, the same. When the dotting gets easy, then you don't need it any more and can forget it.

You will discover some-



thing: You won't like the spring as stiff and heavy as you did before. Not really light, but not heavy at all.

One precaution: Don't let the family or friends hear you going "Dot, uh, dot, uh," because they'll think you're going dotty.

Only you can tell how much it has helped your sending. It will be less "choppy" and "itchy" than before. And you will develop a sense of timing that helps, not only with hand-sending, but also with many keyers. You won't need any "self-completing" feature, because you will be the boss of the keyer, not its victim. I have seen a keyer shake a man like a dog shakes a rabbit – a nervous phenomenon we'll come back to later. Learn to send even dots. It takes less than half an hour, spread over the week, and your sending – even on a printer keyboard – will improve. *And* be easier and more fun.

After dotting, dashing is even easier. Again you time it with words or syllables: "Da da *dash* uh dot uh dot uh dot ha ha ha da da *dash* uh da da *dash* uh da da *dash* ha ha ha da da *dash* uh dot uh da da *dash* uh da da *dash.*" Boy! – what a way to write it! The da-da-dash is all mark, key down, of course. It times the dash as equal to three dots run together, as it should. The "uh" is the unit space as before.

Now, we need a word space. "Uh uh uh" sounds like admonishing the cat, so I have substituted the friendlier "ha ha ha" as a three-unit space.

Of course, you can substitute French or Japanese or whatever, and in any case you don't have to practice this long. You need the practice only so long as it isn't easy. When it is, you have graduated. Don't make work out of it – do it for fun, and see how fast your sending improves.

I have emphasized slow sending – slow and even, with dots and unit spaces of like weight – because this prevents a jittery, choppy style which is hard to read and murder on the fist. It sounds a little heavy, but your dots never "drop out." And when you take your exam you will find that the black, cast iron Beast from Hell with the oil cup on top of it (which the examiner won't let you look at) is adjusted to send perfect code – not that stuff on tapes and records, and even on the air.

A very good check is to watch your plate milliammeter – you *do* have one, don't you? – or, for practice, send into your ohmmeter. Dotting should read exactly half the key-closed value, if you dot at reasonable speed. In the old days, telegraphers used to adjust their bugs this way, using line current as a guide.

If, in spite of everything (and I won't believe this) you still jitter and suffer from nerves when you send, a good stunt is to weight your key. Now you know what the photograph is about! I used a can of meat because metallic lead is poisonous, hard to handle, and more expensive

than the choicest cuts of meat. Any pound weight will do. A pint of milk, a pound of meat – anything. And it won't be wasted – fasten it on the key temporarily, practice a while, letting it slow and steady you down, and then eat whatever it is for lunch. I did, yesterday.

The British have understood heavy keys for a long time, while we laughed at them. We could send twice as fast with our light telegraph keys, while they used a key you gripped with a fist and – it seemed – pumped water with. We laughed, but did you ever see a Limey Sparks with a glass arm?

Again, try to prevent your friends from seeing the weighted key, but if they do, shrug and laugh along with them. Which of you is learning the most, and who is laughing when he could be learning? You're earning your opinions. Let them have their fun.

So far I haven't mentioned the "tapping" technique. There was once a popular radio organization of "A-1" guys called "I Tappa Key." Do you know who taps keys? Old telegraphers with glass arms and their imitators, that's who.

It seems stilted and pretentious (and inflexible!) to sit down with your feet flat on the floor and send with a hand key, using the edge-grip. This is very much like the Palmer Penmanship Method which we Faithful Old Fellows learned generations ago. And this is no accident. If you write a lot by hand, you either use it, or your hand cramps and you wind up writing an illegible scrawl.

Besides, editors demand typewritten material, and for good reason.

While I write like a doctor, I can send with a hand key as long as I want to – with very few errors. *And* with a Bug, *and* with any solid state keyer.

I had a buddy once, who got himself a glass arm. He could not send even one word with his right hand, so he switched over and relearned to telegraph with his left. It was just a matter of time before the left went too, but he got himself promoted and didn't have to telegraph any more. So there is a remedy, but avoidance is the best policy.

And this is easy. The secret is in the key adjustment – you loosen the "trunnions," or the tightness of the needle-and-cone bearings on each side of the key, until you can shake the key lever from side to side. *There must be as much side-play in the lever as there is up-and-down motion between the key contacts.* That's all there is to it.

You won't believe this. That's all right; I didn't believe it either, until I proved it through experiment. The dollar key I mentioned earlier has *no* side adjustment. Either it has cylindrical ears that poke through holes in the U-shaped mounting bracket, or it has conical ears which should be ground into cylinders. Never mind the sloppy feel; your arm is more important than anyone's opinion. You *need* that slop, whatever key you use.

Probably you have a good solid brass key with side adjustments. Well then, unscrew the side screws and lock them at the point that you can move the lever sideways the same amount that you pump it up and down. It will feel "funny," but send a few minutes – at least a paragraph. If you can keep going, do so.

Now adjust the key up snug. Not to binding, or with noticeable friction; just barely enough to prevent side-motion. Now send, and see how your arm feels. Does it begin to tighten up, and do you begin to make errors?

Loosen the key. You may need a couple of sessions to convince you, if you are on the stubborn side, so there is no need to risk your arm while you decide. But the arm, and how it feels, tells the story. Stubborn or no, I know how that key adjustment will wind up! You will never send with a tight key again!

So much for the practice, now for the theory: Our grandparents used to explain any number of things as being the result of "nerves." The trouble with one word explanations is that they don't lay it out for you. In this case, though telegraphers and doctors alike knew perfectly well that Telegrapher's Paralysis was a nervous condition, only the more observing saw any connection between a tight key and a glass arm. And even *they* hadn't the least notion how such a connection might work.

The first clue came from the work of H. S. Black, of the Bell Telephone Labs, who invented negative feedback amplifiers in the thirties. To him the invention meant stable telephone repeaters, and high fidelity at less cost. But to physiologists, experimental psychologists, and other researchers into the living body and its operation, it offered an explanation that had been lacking before. When you put your hand out to touch something, how did the hand stop where you wanted it to? Feedback, by various paths, was a concept that fitted all the observed facts. It simplified explanations; it predicted results. The idea that something caused by the original action that opposed and controlled it was new and exciting.

I have two pocket calculators. One has a keyboard that clicks under finger pressure, like a typewriter key. The other keyboard has keys of the conductive plastic foam type. And be it ever so bounceless, I don't like it, because it feels just like stepping in a cow-clap. It is just mushy; the other keyboard lets my fingers know when to stop pressing, with a click that is felt as a vibration. Expecting this, I actually cracked the circuit board on which the mushy keys were mounted, trying to make them react as expected. I had to cement another board onto it to prevent breaking the printed connections.

Also, I worked for a time at a broadcasting station as a transmitter operator. The on-off buttons controlling the circuit breaker for the high voltage were of the industrial type. They were spring-loaded and all that, but had absolutely *no* follow at all. Everybody hated them – you couldn't tell anything by feel. They gave a disconcerting impression of *anticipating* you, as if they operated while you were only *thinking* about pushing them.

Ask any target shooter what a bad trigger pull will do to his scores.

The fact is that most of us are confused and uneasy when something doesn't "feel right." This applies to telegraph keys, too. The rigidity of the side-adjustment, the absence of side-play, dulls and reduces the feedback that monitors what flows out of our brain, down the arm to the fingers, and into the key. This is my theory. No one else has ever said that this is true, so far as I can find out – and I've tried! – if only because telegrapher's paralysis is as dead as its victims, for the most part. It is one of the rarest of diseases, *so far as telegraphing goes*, but it has other manifestations, and should, by all means, be understood.

We have to have feedback, lest the nerves rebel through confusion. I have seen a man

standing, back arched, face contorted, arm stiff, trying to telegraph by tapping. I didn't laugh. Telegraphing was part of his job, and for him it was torture. Of course, he could send like a streak with a bug. If you check the old ads, you will see that they claimed "ease" and "speed" as selling points. But bugs were and are very expensive – aside from a few broker operators, most sales were to telegraphers who had glass arms. They were as helpless without their bugs as a present day grammar school student without his pocket calculator.

Lyall Watson, in his book *Super Nature*, has some interesting things to say. He tells of experiments in 1946 in which Grey Walter and his colleagues used flashing lights during brain wave tests and their patients went into convulsions. Other workers have had similar results when the rate of flashing coincided with certain brain wave patterns. The most consistent seizures occurred when the brain waves themselves were made to trigger the light, something like a buzzer or multivibrator action. Under this arrangement, half of the patients had spasms. And they had no history of epilepsy! Watson also mentions a bicyclist who blacked out while riding down a lane with trees along its sides. When the sun was low enough, the flickering produced by riding past the line of trees was enough to cause blackout – not just once but several times. How many mysterious automobile accidents, do you suppose, are caused by something like this?

In 1927 I went to work for AT&T. I knew a little International Morse, not much, and I discovered that Morse was quite a lot different. It was faster, too, once you learned to read spaces between clicks instead of tone pulses.

There was a full telegraph department with a few printer circuits, but mostly hand-operated Morse. In the test room, where I worked, there were at least a dozen "test wires." These were simple Morse circuits with a sounder mounted high, well above the jack-fields, next to the carvings of "Nekkid Wimmen" which were standard decoration in those days. Now we got plastic strips. Down on the keyshelf in a clutter of switch-keys and cord-circuits and such, dwelt the telegraph keys. The clutter was not conducive to good sending, but we had men who could do it. For one thing, telephony was just something added to their Morse experience. They were operators; that is how they got their jobs. They learned how to operate a Wheatstone Bridge, and gain a repeater, and that was about it. The test wires were used for communication between offices.

In those days, a telephone route between cities was likely to have just one standard 40 wire line. Open wire, not cable. That meant 20 side circuits, ten phantoms, thirty phone circuits in all. The side circuits were all composited (a composite set was a low pass filter) and a telegraph wire – nearly always half-duplex – could be connected to each wire, giving forty telegraph wires, two way. That is where the name "and Telegraph" comes from. These did not carry public messages, by agreement with Western Union; they were all either leased wires, or test wires.

You had to be conscious of your own office call; when you heard it, you interrupted the circuit to "break" the distant operator. When you heard the wire close, you said "I" and listened to his first words. Invariably he wanted something simple, and, while he was telling you, you walked away and did the job, listening all the while. Then you came back a few seconds later and said OK. The most convenient system you ever saw; it took a lot of effort and determination for the High Brass to kill it. We liked it. Radio Traffic men are aiming at such operation with their "break-in."

I was just a kid then; my co-workers were 30 to 60 years old. The older men got bored when work was light and they weren't kidding me. Then they resorted to horseplay. A favorite gambit was to loosen the trunnions to the critical point so that when the key was touched, the lever would explode out of it like a mousetrap and the spring would be lost. The victim had to try sending with the switch-lever, by which the circuit was kept closed while idle. This is like telegraphing with a knife-switch, and he would swear loudly to the delight of the perpetrators.

As I say, I was young. This did not suit my sense of propriety. Besides, I had noticed that, even when in working condition, the adjustment was very sloppy. So to be helpful I would tighten them to what I thought was the "proper" adjustment. In other words, I was a wise guy, just as the kids are today, and for the same reason: ignorance.

My "adjustment" never lasted long, so one day I took a pair of gas-pliers and tightened all the lock nuts. And then it really hit the fan. Grown men running up and down and cursing and threatening mayhem and worse for the unspeakable scoundrel who not only messed up all the key adjustments but had the unutterable gall to LOCK them that way! I watched them searching behind the test-board and under the duplex tables and even up on the cable racks for the dastard, whoever he might be, while I was in plain sight and feeling a little exposed. I knew who it was, all right. It was me. I was dimly aware that I was being taught something, and with more tact and good humor than I deserved. Later I, too, put on a show of rage and incipient insanity when, as a chief, I had to make a point! You can't do it often, but it works, it works! The difficulty is in keeping your face straight.

I asked one of the older men, who had been patient with me, what it was all about. "Don't you know? Send on a key without side-play and you get a glass arm!"

My informant was one of the few, even in that office at that time, who knew what caused Telegrapher's Paralysis; he knew that it was due to bad key adjustment and "nerves," and that was as much as anyone knew. In the years since, I have asked questions at every opportunity and so far have had not one answer that means anything. I have puzzled over it for those same years, and the work of Norbert Weiner and others gave me my first clue. It is entirely possible that I am the only man alive who actually does know; I hope not, and would be delighted to hear from anyone else who does. But I am afraid that, until now, I have been a torch bearer.

This story will undoubtedly be classified under Dewey Decimal System in some library or other, and will still be obscure. However, it will be in print, and not locked up in the heads of dead men. The knowledge, aside from help to key men, might even furnish an important clue to the psychologists and other workers in the field.

Be that as it may, you have no excuse for acquiring a glass arm. You know better. ■

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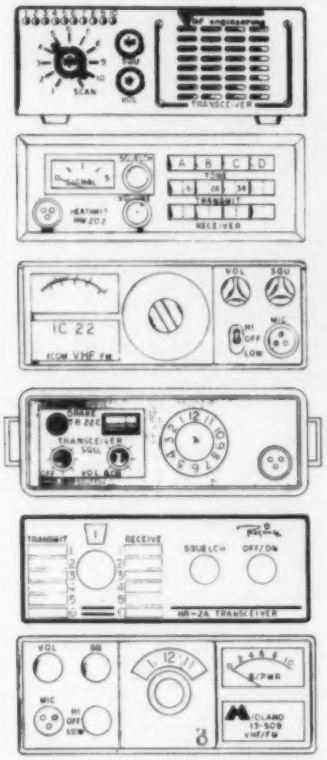

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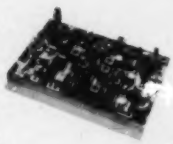

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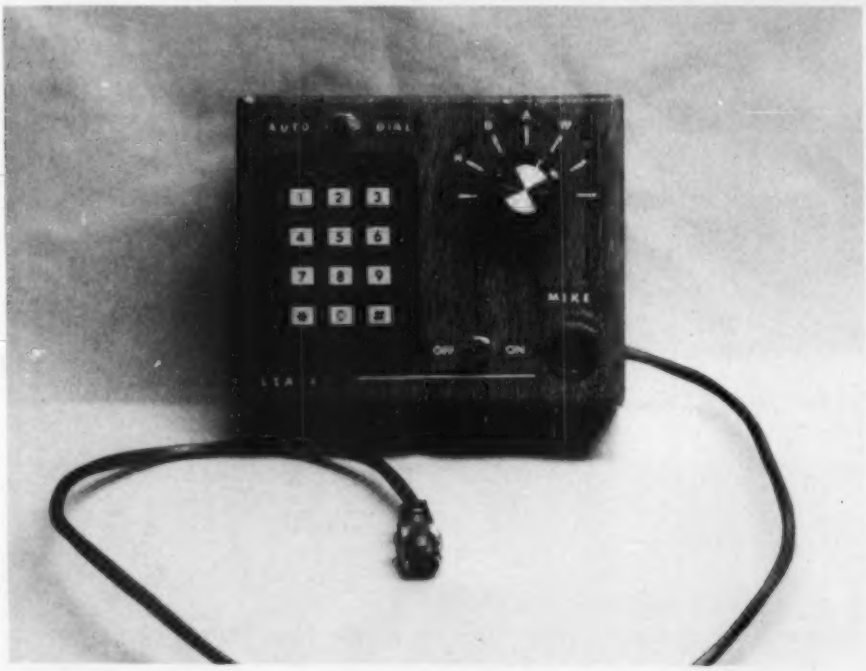
Mobile Autodialer

-- six preprogrammed numbers

Most of us seem to dial 4 or 5 numbers most often when using autopatch. And it always seems you decide to make that important call when you're up to your ... ah ... bumper ... in traffic. This situation, and a near miss on the expressway, is why I felt the need for the WB9LTA autodialer – and, of course, the never ending "need" for a new gimmick.

The features of this autodialer are: rapid, error-free dialing of any one of 6 preprogrammed phone numbers; automatic transmitter keying; simple operation – set the rotary switch and push the activation button; optional keyboard for unprogrammed numbers; optional acoustic coupling; and rock stable touchtone generator, requiring no tuning.

The heart of the autodialer is a new McMos® chip from Motorola, the MC14410P. This is a 2 of 8 tone encoder, specifically designed for touchtone applications. It uses a 1 MHz crystal divided internally to generate the basic tones. It is accurate to ±½%, well within the specs required to key Bell TT



Front panel; PC board, top view.

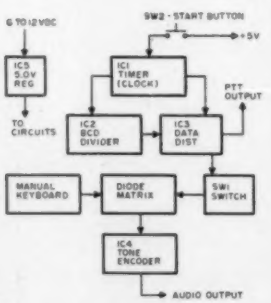


Fig. 1. Block diagram.

circuits. To achieve the sequential dialing necessary to dial a phone number, a 1 of 16 data distributor stepped by a BCD decimal counter was chosen. A NE555 timer was chosen to provide the clocking for the circuit.

The only really critical parts of the circuit are the tone frequencies, which are controlled by the MC14410 and the crystal; the digit pulsing rate, which is controlled by the 555 and R2; and the interdigit time, which is controlled by the programming of the outputs of the 74154. A note regarding the digit and interdigit timing: Bell specs call for a 75 msec tone pulse, separated by a 25 msec interdigit space (worst case specs), to reliably access Bell equipment. Some offices may respond to faster pulsing, but not all will. This circuit is designed to fit these specs, with some "security hedge" built in.

How It Works

First, a word of explanation: I am not an engineer. I look on ICs as "little black boxes." I don't understand how many of them work, or what's in them. All I care about is what can be done with them, and how to wire them together to make them do the job you want done. Don Lancaster's book, "The TTL Cookbook," has been a great help here. But just plain "trial and error" has been my best teacher. With that, here goes an explanation of how this device works (refer to Fig. 1).

When you push the start button, IC1 starts. IC1 is wired as an astable multivibrator, with the frequency controlled by R2 and C2. The output of IC1 is fed to IC2. IC2 is a decimal divider which puts out a BCD sequencing code at the rate dictated by IC1. The BCD outputs of IC2 are applied to the inputs of IC3, a 1 of 16 data distributor. The outputs of IC3 will be brought to logic 0, one at a time, then will go back to logic 1. The rate at which this happens is controlled by the clock (IC1). Which outputs change is controlled by IC2. The outputs of IC3 are routed through switch 1 to control which digit tones are applied to the audio output at any given time. Note that only every other output of IC3 is used; this provides for the interdigit timing (which is equal to the digit timing). Switch 1 is the programming device. It controls the sequence in which the numbers are dialed, and which numbers are dialed. The diodes on the inputs of IC4 and the outputs of IC3 connect (by jumpers) to switch 1, and form the programming matrix. IC4 is the tone generator. It has seven inputs, which correspond to the seven basic touchtones. When a low tone input and a high tone input are brought to ground simultaneously, a TT digit is generated. See Table 1 for which inputs generate which digits.

The high group and low group outputs are combined through isolating resistors to give the digit output. The digit output is coupled to the rig through the coupling cap, C7. R6 controls the output level. If acoustic coupling is desired, the optional amplifier consisting of Q2 and Q3 is used, and is direct fed from the level control pot (R6). C7 is not used in this application.

PTT control is achieved by applying the pulse at IC3, pin 16 to the base of switching transistor Q1. The collector of Q1 provides a ground path to activate the PTT circuit in most rigs when Q1 is biased on. If your rig uses a positive voltage, or diode switching to activate the PTT, then you will have to use the optional circuit shown.

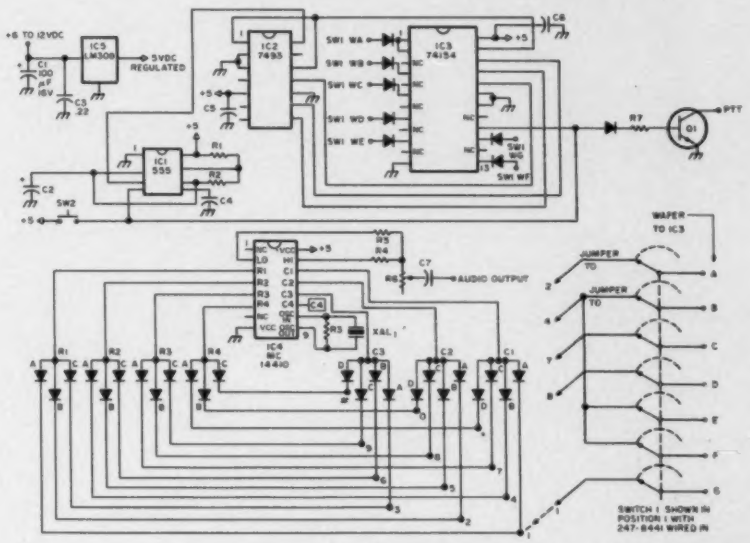


Fig. 2. Schematic.

Construction

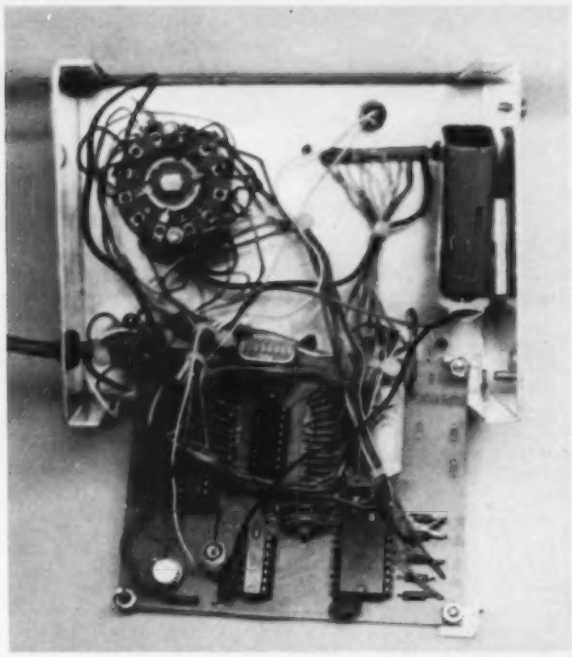
Parts procurement may be a problem in some cases, especially in obtaining IC4, its associated crystal and SW1. Sources for these parts are provided in the parts list. The optional tone pad is also a problem, and again, sources are in the parts list.

A PC board is the most desirable way to build this project, and a layout is provided. Etched boards are also available. A vectorboard could be used, but the number of diodes in the matrix may make the final device unreliable unless you epoxy the diodes to avoid movement.

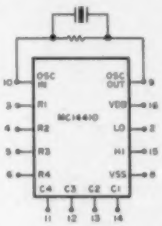
Assembly is straightforward, with no special precautions needed except in handling IC4. Since it is a CMOS device, it is subject to damage from static electricity. Do not remove it from its carrier until you are ready to insert it into the circuit. At that time, you should run a strap from your wrist to an earth ground, to bleed off any static buildup on your hand. DO NOT touch anything electrical in your shack while you are grounded. If you work on a wood, concrete, or tile floor and wear rubbersoled shoes and cotton clothes, static buildup is unlikely, and you needn't ground yourself.

Wiring the jumpers in the diode matrix requires some care, to be sure the correct digit tones will be generated. Refer to Table 2 for these connections.

To simplify construction, program the individual phone



PC board, bottom view; internal wiring view.



Digit	R input	C input	
1	R1	C1	Standard TT digits
2	R1	C2	
3	R1	C3	
4	R2	C1	
5	R2	C2	
6	R2	C3	
7	R3	C1	
8	R3	C2	
9	R3	C3	
*	R4	C1	
0	R4	C2	
#	R4	C3	
A	R1	C4	Special control digits
B	R2	C4	
C	R3	C4	
D	R4	C4	

Table 1. MC14410 Digit Connections.

Jumper from Diode	to	Diode	for	Digit Output	to Switch 1
R1-A		C1-A		1	
R1-B		C2-A		2	
R1-C		C3-A		3	
R2-A		C1-B		4	
R2-B		C2-B		5	
R2-C		C3-B		6	
R3-A		C1-C		7	
R3-B		C2-C		8	
R3-C		C3-C		9	
R4-A		C1-D		*	
R4-B		C2-D		0	
R4-C		C3-D		#	

Table 2. Diode Matrix Jumpering.

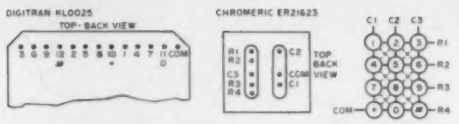


Fig. 3. Keyboard connections.

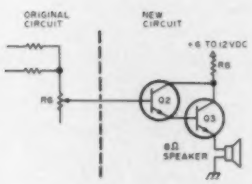


Fig. 4. Optional audio amp.

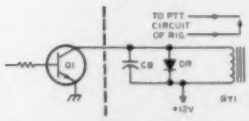


Fig. 5. Optional PTT methods.

numbers on switch 1 before wiring the jumpers from IC3 and from the diode matrix to it. When programming SW1, avoid confusion by labeling the various wafers of the switch with A through G. "A" corresponds to the first digit of the phone number and to the point on the diode matrix to which it will be attached. "B" corresponds to the second, etc. The wiper for wafer "A" will connect to diode "A" on the board, etc. Position 1 on each wafer will be used to program the first phone number, position 2, the second, and so on. Refer to Table 3 for an example of programming. Note that any digit is only brought from the diode matrix to the switch once. Whenever that digit is needed in programming again, simply jumper it from another point on the switch which represents the same digit. In the example shown in Table 3, the digit "4" was brought to switch 1, wafer B, position 1 from the diode matrix. Then jumpers were used from wafer B, position 1 to wafer E, position 1, and from wafer E, position 1 to wafer F, position 1 to wafer G, position 2.

After the phone numbers are programmed on the switch, then bring the jumpers from the diode matrix to the necessary digit and wiper points on SW1. Now, recheck the programming for errors. Trace from the R positions on IC4 to the C positions to verify the correct tones as shown in Table 2, then trace the wiring through SW1 to verify that the correct phone numbers exist in each position. This should complete the switch programming.

If a keyboard is used, jumper from each digit on the diode matrix to the correct pin on the keyboard, referring to Fig. 3 for the pinout on the specified keyboard. Other keyboards may be used, but they should provide a common contact on each digit, and an isolated contact for each digit. A multiplexed board will work, but it still must have a common contact for ground in each digit. A 16 digit keyboard may be used, but diodes are not included in the matrix, and would have to be added.

It is suggested that sockets or molex type pins be used on all ICs. Also, use a good grade capacitor for C1 and C2, and a 5% resistor for R2, 4, and 5. Other part values are not critical.

Testing

Prior to testing, double-check all wiring – ICs are great till you apply voltage to the wrong point! Also recheck the PC board for hairline trace bridges, or solder bridges; I had 3 solder bridges on my prototype.

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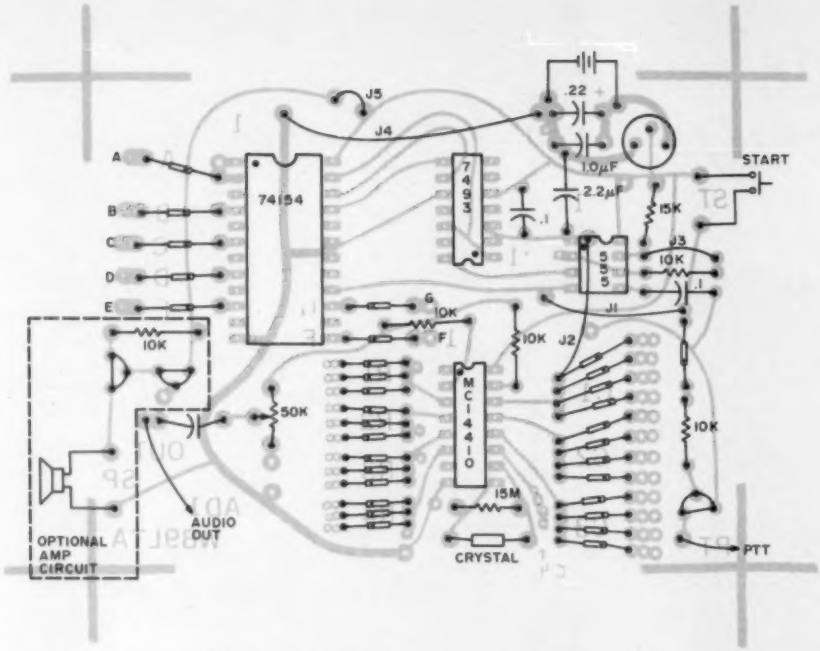

Fig. 6. Component layout (full size).

Once satisfied with the wiring, apply voltage, using a 9 volt transistor battery or a 12 volt power supply. Attach a voltmeter to the output of the LM309H and check for 4.5 – 5.5 V dc. If voltage is above or below these limits, remove power and recheck wiring; if the voltage was more than 1 volt above the 5.5 volt level, you may have damaged one or more of the chips. If the voltage was too low, check the LED, then the chips. Of course, don't overlook the LM309H. If it was inserted incorrectly, it will probably be damaged. One other word of caution: NOTE that the 7493 is inserted with pin 1 down toward the MC14410, just opposite of the rest of the chips.

Assuming that the voltages are OK, the next step is to check the tones. I used a small transistor amplifier, connected to the output capacitor, to listen to the tones. When you push the start button, you should hear a burst of tones. If not, you may have a wiring error, or poor connection. Next, test the tone chip by attaching a jumper to ground, then touching the unattached clip to each of the R and C pins on IC4. If you get tones, next touch the clip to the TT digit output (the outputs that go to SW1). Again, you should hear tones. One way to verify the accuracy of the tones is to use a touchtone phone. Listen in the earpiece while pressing the same digit on the telephone and the autodialer – you should hear a beat effect, which tells you that the two are close.

If all of this testing proves the unit is working, you should check the PTT transistor Q1. Clip an ohmmeter between ground and the collector: When the start button is pushed, the ohmmeter should show a low resistance reading (10-60 Ohms). If all of this works, your autodialer should work. Attach it to your rig and try it!

If the unit does not give a tone burst when the start button is pushed, but the tone generator is working, the problem most likely is in the 555. Recheck the wiring around it, and the timing components, C2 and R2. If a scope is available, check pin 3 for an output pulse. I have encountered a few defective 555s obtained surplus, so this may be a consideration.

If the unit dials too fast or too slow, C2 or R2 are of incorrect value. Cheap capaci-

	Phone # Digit	SW1 Wafer	SW1 Position	Digit Output	Point in matrix where or jumper should come from	Point on SW1 where jumper should come from
First Phone Number	2	A	1	2	Diode C1-A	
	4	B	1	4	Diode C1-B	
	7	C	1	7	Diode C1-C	
	8	D	1	8	Diode C2-C	
	4	E	1	4		SW1 Wafer B Pos 1
	4	F	1	4		SW1 Wafer E Pos 1
	1	G	1	1	Diode C1-A	
Second Phone Number	5	A	2	5	C2-B	
	5	B	2	5		SW1 Wafer A pos 2
	5	C	2	5		SW1 Wafer B Pos 2
	1	D	2	1		SW1 Wafer G Pos 1
	2	E	2	2		SW1 Wafer A Pos 1
	3	F	2	3	C3-A	
	4	G	2	4		SW1 Wafer F Pos 1
Third Phone Number	2	A	3	2		SW1 Wafer E Pos 2
	2	B	3	2		SW1 Wafer A Pos 3
	2	C	3	2		SW1 Wafer B Pos 3
	2	D	3	2		SW1 Wafer C Pos 3
	3	E	3	3		SW1 Wafer F Pos 2
	6	F	3	6	C3-B	
	9	G	3	9	C3-C	

Other phone numbers would follow this pattern.

Table 3. Example of SW1 Wiring.

tors are rarely close to the stated value, so if you bought an inexpensive unit, that may be your problem.

One helpful test fact: The current draw of this circuit is about 100 mA. If trouble occurs, this would be an important thing to check. Higher current indicates a potential short (probably on the board), while lower current indicates a potential open (probably a poor solder joint).

The final item to check is the numbers your autodialer is dialing. If it dials an incorrect number, you've made a mistake in your switch programming.

Operation

Operation is simple: Apply the power, select the number to be dialed with SW1, and push the start button. Presto, you have your party!

A few notes are in order. When power is applied to the unit, the dialer will sequence, then stop, so avoid turning the unit on where it might interfere with a QSO. If you choose a 9 volt transistor battery as your power source, use a mercury or nicad cell, as an alkaline or carbon-zinc cell will cease to operate in extremely low or high temperature. The best source of power is your car battery. If your dialer malfunctions, it is most likely the power supply. If you get unreliable dialing, the problem is probably one of excessive speed. Adjust R2 upward in value. If the audio output is too low, it may be necessary to adjust the value of R4 and R5. Do not go below 1k Ohm for these resistors, however. If you still don't have enough audio to drive your rig, you may need to add the optional amplifier. Another problem area was recently brought to my attention: Some rigs are using audio circuits which provide base attenuation. In these circuits, it may be necessary to juggle the values of R4 and R5, maybe such as 1.5k for R5 and 1.0k for R4. DO NOT juggle these values unless you find (with a scope) that the high and low tone groups are more than 4 dB apart in level.

Finally, select an enclosure for your autodialer. I used a 3 x 4 x 5 inch minibox because it is inexpensive. I covered it with contact paper, then marked it with Datak dri-transfers. You may wish to go with a more deluxe enclosure, such as a LMB442 or a sloped panel box. I do recommend a metal enclosure.

Hookup to your rig may be accomplished any number of ways. In my unit, I used a jack identical to that used on my TR-22, mounted on the front panel of my autodialer. I attached a short length of 3 conductor cable from the common, audio-output, and PTT outputs of the autodialer, to a plug to match the jack. I then plugged my mike into the autodialer, and plugged the autodialer into my rig. You could put an accessory plug (some rigs already have one) on the back, and feed the PTT, common, and audio to the rig this way.

I would like to give credit to K9OMS, who spurred this idea by building an autodialer some time ago, proving to me that the basic idea was sound. I would also like to thank WB9SFF, WB9PAR and K9JRI for their technical assistance in developing the final product. Finally, the XYL deserves a lot of praise for her tolerance of my time spent in the shack working on this project. ■

Parts List

Quantity	Designation	Description	Source
1	IC1	NE555	Digi-key, James, Poly Paks, etc.
1	IC2	SN7493	Digi-key, James, Poly Paks, etc.
1	IC3	SN74154	Digi-key, James, Poly Paks, etc.
1	IC4	MC14410	Data Signal Co.
1	IC5	LM309H	Digi-key, James, Poly Paks, etc.
1	Q1	2N3904	Digi-key, James, Poly Paks, etc.
32	Diodes	1N914 or equiv.	Digi-key, James, Poly Paks, etc.
1	C1	100 uF/16 V dc	Digi-key, James, Poly Paks, etc.
1	C3	0.22 uF Mylar	Digi-key, James, Poly Paks, etc.
1	C2	2.2 uF/16 V dc	Digi-key, James, Poly Paks, etc.
1	C7	1.0 uF non-polarized	Sprague 225P10591YD3
3	C4, 5, 6	0.1 uF disc	Various
4	R1, 4, 5, 7	10k Ohm ¼ W 5%	Various
1	R2	15k Ohm ¼ W 5%	Various
1	R3	15 M Ohm ¼ W 5%	Various
1	SW1	7 pole 5 (or more) position rotary switch	Centralab PA 1027
1	SW2	N.O. momentary contact push-button switch	Various
1	XAL1	1 MHz ±0.1% 7.0 pF 540Ω crystal	Manann Labs ML 18P
1	R6	50k Ohm lin. taper trimpot	Mallory MTC 54L1
Optional Parts			
2	Q2, 3	2N3904	Various
1	R8	1k Ohm ¼ W 5%	Various
1	RY1	SPST N.O. relay	Magnecraft W 102 MPCX-8
1	DR	1N4001 diode	Various
1	C8	0.1 uF disc	Various
1	SW3	SPDT power switch	JBT #JMT 123
1	KB	TT keyboard	Digitran KL 0025 or Chromeric ER 21623

Kits Available

AD1	Complete Kit – All parts, PC board (drilled) and AD4B switch. Less case and battery	$65.00 pp
	For AD4A switch, add	4.00 pp
AD2	Chip Kit – MC14410, 7493, 74154, 555, LM309K 1-2N3904, 1 MHz crystal	30.00 pp
AD4A	Switch 1 – 7 pole 9 position rotary switch	10.00 pp
AD4B	Switch 1 – 7 pole 5 position rotary switch	6.00 pp
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Optional parts not available from kit source.
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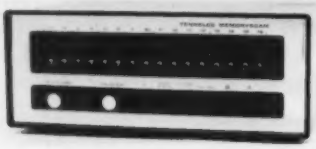

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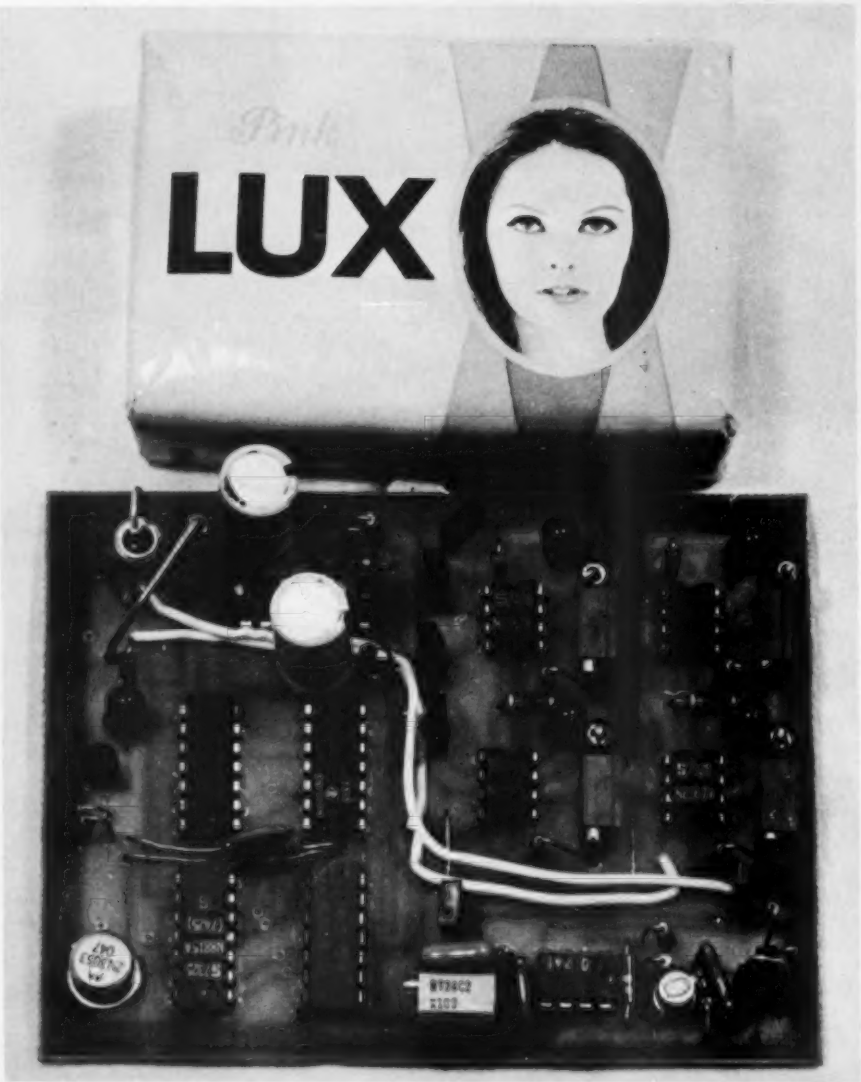

The purpose of this circuit is to allow the user to monitor a radio channel without having to listen to constant chatter, and yet be available for call. This unit may be used with any radio, and will work on any simplex or repeater channel the radio is tuned to. The circuit uses no special hard to get coils, or other rare parts, and is easy to tune and set up. As shown, the unit will respond to a three digit Touchtone code, but with minor changes the unit can be made to respond to any number of digits.

When the operator wishes to use the device, the audio input plug is inserted into the external speaker jack provided on most radios. The unit will monitor the channel for the programmed series of Touchtone numbers in the proper order, during a predetermined "window" of

The Touchtone sequence decoder. A zener diode and resistor may be used in place of LM309. Zener type 1N751 and resistor value of 68Ω, 2 Watts are suggested. Undrilled PC boards are available from the author for $3.50 each.

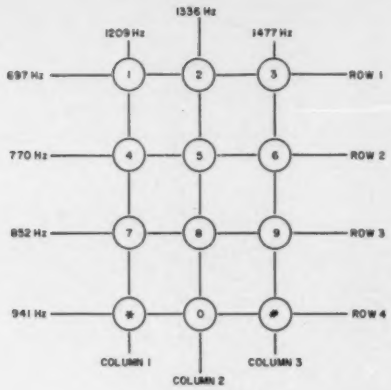

Fig. 1. Touchtone pad frequencies.

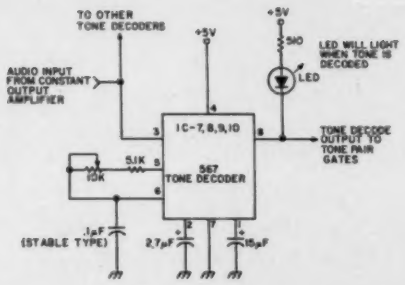

Fig. 3. Tone decoder using 567. Circuit repeated four times.

time (all three digits must be received during a measured time period). When the proper three digit code is detected, a latch will set, enabling a light which shows that the unit has been paged, and also enables a transistor which can key a buzzer, fire a cannon, or even key a relay turning on a speaker letting you hear the channel and your call. This key will time out after five to ten seconds, depending on values used, while the light will remain lit until reset manually.

Circuit Description

The audio goes into a constant output amplifier (Fig. 2). This amplifier will provide a constant output level to the tone encoders even though the input level may vary over a range of 50 mV to more than 6 volts. This constant level audio is distributed to four 567 tone decoders (more could be added). Each tone decoder is tuned to detect one tone in the Touchtone matrix, which has seven tones, of which we only use four. Under normal conditions, two decoders would be tuned to the columns, and two to the rows (refer to Fig. 1). The output of each decoder is fed into gating (IC1) where the tone pairs are determined. The output of each tone pair gate is a digit decode (example, column 1 and row 1 = digit 1). These four decoded numbers go both to the sequence logic and an "OR" gate which triggers a oneshot (Fig. 4). This oneshot will trigger any time a number is decoded, and will enable the sequence logic for a time period, forming a window, which resets the logic when time-out occurs.

The sequence logic is simply three flip flops which can be set only in the wired, predetermined order. This may be wired by using three of the four decoded numbers connected to the proper gate in the desired order. An example would be: if I decode columns 1 and 3, and rows 1 and 4, my four decoded tone pairs, or digits, would be 1,3,*, and #. If I were to wire the decoded number 1 to pin 9 of IC2, the decoded number 3 to pin 9 of IC3, and the decoded symbol

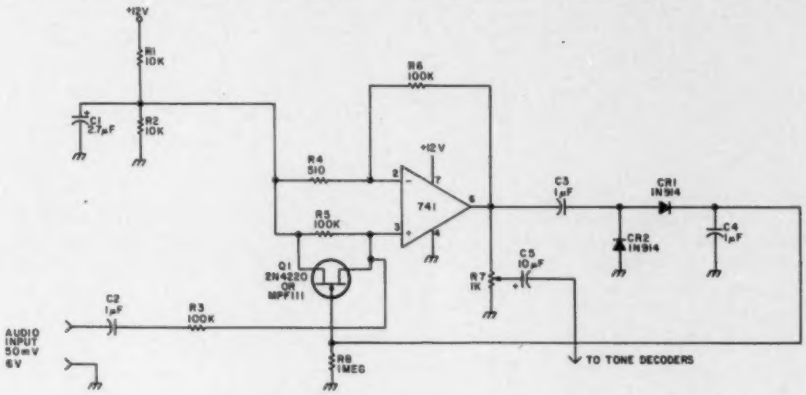

Fig. 2. Constant level audio amplifier.

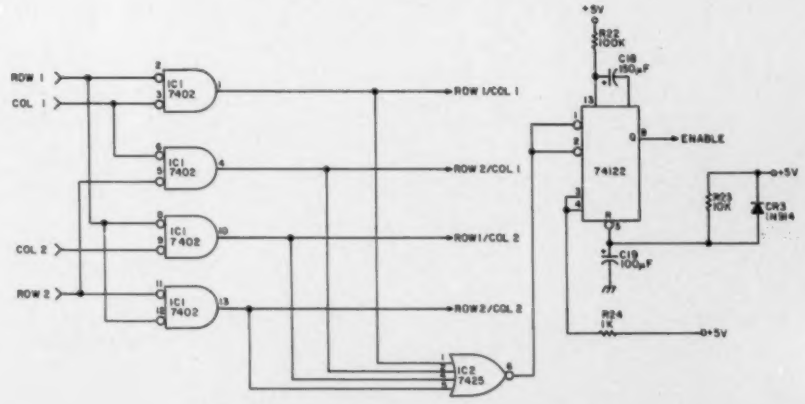

Fig. 4. Tone pair decode, window enable.

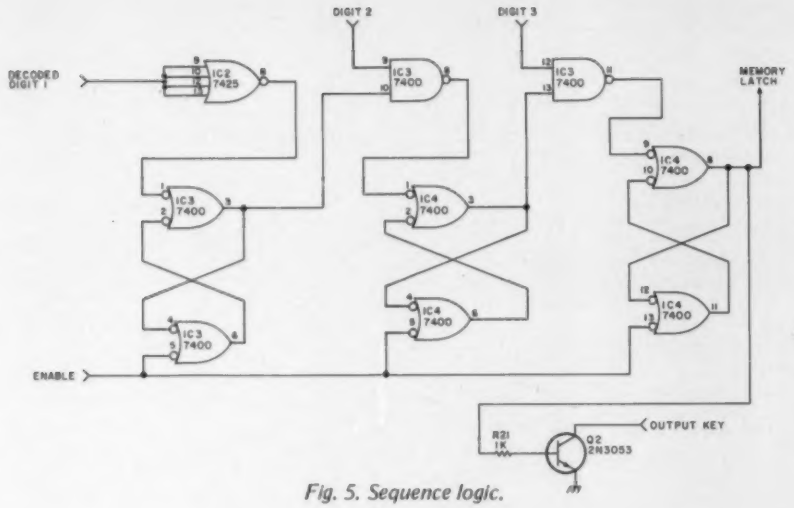

Fig. 5. Sequence logic.

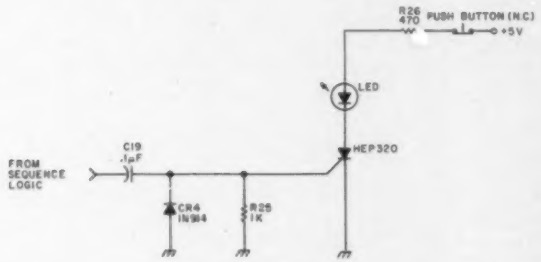

Fig. 6. Memory latch.

to pin 12 of IC3 (Fig. 5), my unit would respond to the call of 1-3-#. As you can see, the fourth decoded digit is not used. If the builder wishes to expand his call to four digits, this can be done by the addition of another flip flop and gate wired onto the end of the sequence logic chain.

When the proper code is received, the memory latch (Fig. 6) will set, until reset by the user, and the output key will turn on for a period of time which will end when the window times out and the unit resets, in about five seconds with the values shown.

Tuning

To set the tone decoders for the desired decode, connect the input of the sequence decoder to a Touchtone signal source. After adjusting R7, the output of the constant level amplifier, so as to drive the tone decoders with about 100 mV of audio, pick the first column to be decoded and generate this tone (if using a Touchtone pad, hold two keys in desired column simultaneously, and this will provide the tone for that column; the same holds true for the rows). Adjust the tuning resistor on the 567 tone decoder desired, until the LED in its output lights. Move to another 567 decoder and repeat this same procedure with the second column, and then repeat again for each row. With the outputs of the tone decoders wired to the pair gates as shown, each of the four gates will have a HIGH output corresponding to its tone pair input. The unit is now set up to recognize four tone pairs, of which the order of recognition is determined by the wired order to the sequence logic.

The unit built by the author has been in use for some time and is constantly connected to the audio output of the receiver. The unit has proved to be stable and reliable, decoding the tones even while the incoming signal is noisy or the person sending is talking on top of the tones. My unit has *never* falsely gone off due to voice or noise on the channel. ■

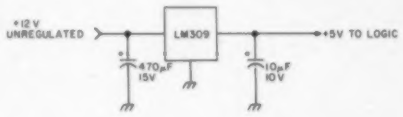

Fig. 7. Power supply regulator.

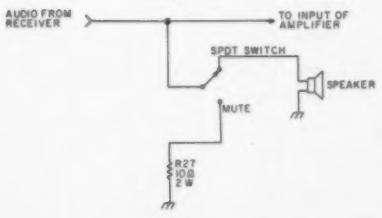

Fig. 8. Speaker muting switch.

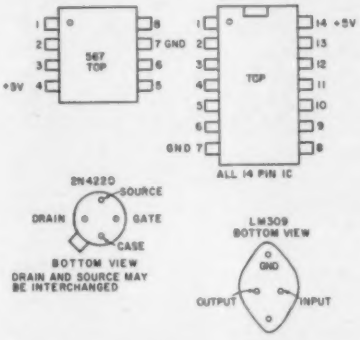

Fig. 9. Semiconductor pin arrangements.

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82.5	YZ	141.3	4A
85.4	YA	146.2	4B
88.5	YB	151.4	5Z
91.5	ZZ	156.7	5A
94.8	ZA	162.2	5B
97.4	ZB	167.9	6Z
100.0	1Z	173.8	6A
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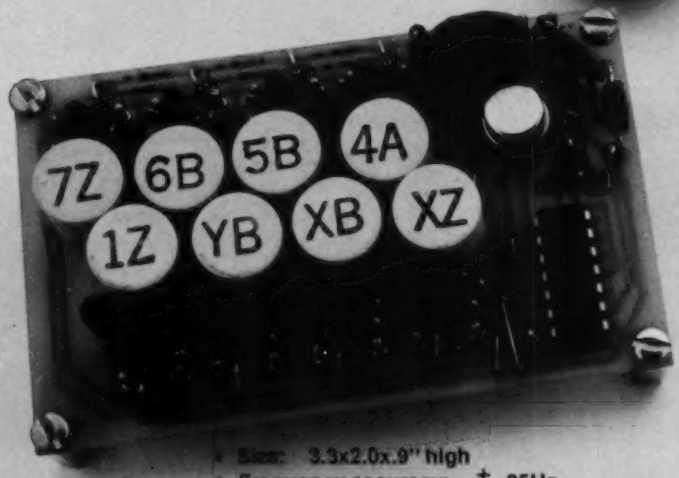

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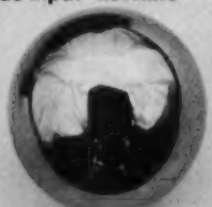

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Build This Lab Type Bridge

-- and measure transformer impedances

Arny Cain WB4FDQ
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Hold it! Don't let the title scare you away. This is not an article written strictly for engineer types, but just the opposite. Considering the fact that I have been playing with electronics (we used to call it just plain radio) since 1933 and only just discovered Ohm's Law about eight years ago, you may understand that I am far from academic-minded. As a matter of fact, I was never graduated from high school and only got a college degree in 1973, but that is another story. Truth to tell, I have always been one of that vast army of cut and try chaps who are scared silly at anything that even remotely resembles an algebraic formula. This is also the reason, indirectly, that I built this valuable tool and worked out my own cut and try method of solving a nagging, typical ham problem.

It all started back in the mid-60's when I was building the modulator for a two meter rig. I needed a transformer of a specific input and output impedance, in Ohms of course. Since I had (and still have) about a hundred transformers (all unmarked, of course) lying around, and since at that period of history I was working at the Space Center at Cape Canaveral, it

was no trick at all to take a few likely-looking prospects into one of the many electronic labs. Telling my problem to a group of sympathetic, highly trained, and highly paid engineers brought instant cooperation. Unfortunately, sophisticated labs not withstanding, several hours later we still did not know the impedance of any of the transformers. Greatly disappointed, I gathered up my "boat anchors" and decided that there must be an easier way. I finally bought the proper modulation transformer and got the rig on the air, but in the back of my mind the determination to find an easy way out of this dilemma remained.

Well guys, after an interval of about ten years, here is the simple solution. Three pieces of equipment are needed, two of which you probably have. The first is a signal source at about a thousand cycles (you can use sixty cycles in a pinch), since I understand that most audio transformers are measured at this frequency. The source should have an output of about five to ten volts, although it can be less if you use a sensitive oscilloscope for the null detector, which is the next piece of gear that you need. You can use a VTVM, a scope, a simple old 6E5 magic eye null detector, or (if you have enough signal) an ac micro-ammeter (not recommended). The third and last thing that you will need is (the reason for this article) an instrument improperly called a Wheatstone Bridge.

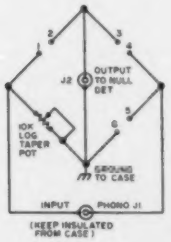
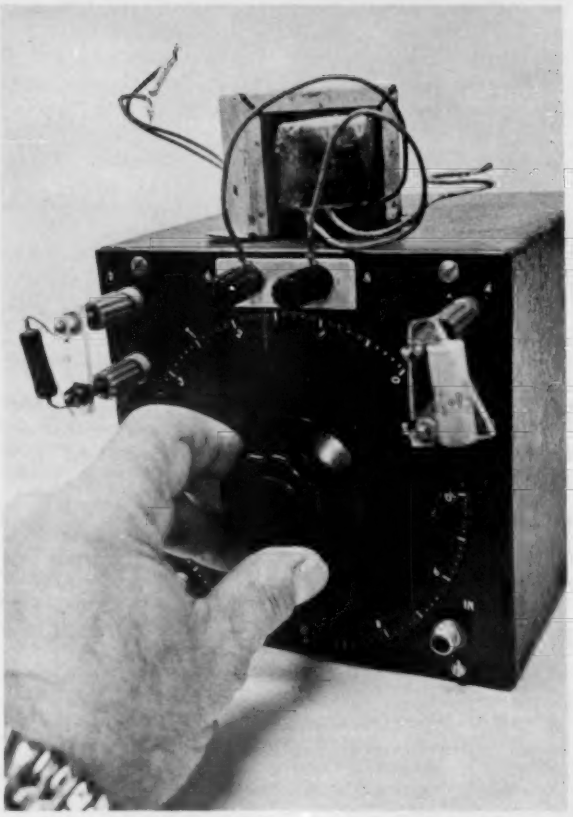


Fig. 1. Schematic.

Please don't rush for your pen to defend old Sir Charles Wheatstone. I'm not trying to deprive him of his place in history, but the fact is that he just didn't invent the darn thing. True, he publicized it, but the device was invented by an English scientist named Samuel H. Christie in 1833. At any rate, this simple piece of gear is the solution (I'll explain how I used it to beat the unknown transformer problem in a moment) to not only the above problem, but to so many others on the workbench that I now wonder how I ever survived in this hobby without it. Considering its simplicity (see schematic), it is perhaps the most valuable instrument that I own.

Now for the construction data, which will be meager because no one will build a carbon copy anyway. First, don't use a standard volume control for your calibrated pot. They are just too small to permit any degree of accuracy and/or resettability. As you will observe in the photos, the potentiometer that I used is a 5½" diameter, wire wound, 10k Ohm log taper job made by the Muter Company and, I believe, long since discontinued. I've had mine for about 6 or 8 years and I think that I bought it by mail from one of the surplus houses that advertise in *73*. I do remember that I paid $3.95 for it and it's probably worth ten times that. You don't have to have one that big, but try to get a pot over two inches in diameter.

Wire with heavy leads, the heavier the better (I used number 14 wire), and make sure that you use well-insulated binding posts. One more thing, before I forget: Be sure that your signal input connector is well insulated from the chassis. As you can see in the photos, my plug-in resistor jacks are made using banana plugs on pieces of Lucite. The reason for the funny shape (the Lucite) is that I had a bunch of three prong connectors from a long since defunct grid dipper. All I had to do was to remove one banana plug; ergo, funny looking jacks. The only other components that you will need are some precision resistors and capacitors, preferably 1% (see list). The accuracy of the instrument depends on two things: the precision with which you calibrate your dial, and the accuracy of the standard resistors and capacitors that you use.



Connect unknown resistor between 5 & 6

Range (Ohms)	Posts 1 & 2 Std. Res.	Posts 3 & 4 Std. Res.
.1 – 1	10,000	1
0.1 – 10	10,000	10
1 – 100	10,000	100
10 – 1000	10,000	1000
100 – 10,000	10,000	10,000
1000 – 1000,000	1000	10,000
10,000 – 1 Meg	100	10,000

Table 1. Resistance Measurements.

I made my dial six inches in diameter using a large skirt knob and a flange from a daylight load spool from 16mm movie film. I filed a flat on the shaft of the pot so that the dial would never slip and would retain its calibration if it should ever have to be removed. After the instrument was assembled I sat down with a handful of precision resistors and my VOM

to calibrate. I hooked my ohmmeter across terminals #1 and #6 and marked the dial carefully with a pencil, checking every reading against a known 1% precision resistor wherever possible. Later I applied white press-on numbers and dots and sprayed them with clear lacquer to protect them. The calibration procedure is not difficult, just tedious. Calibrate the major 1k Ohm points first and then the 100 or 200 points in between. The more careful you are, the more accurate your bridge will be.

As you will note in the photographs, I used standard RCA phono jacks for input and output. I use them whenever possible on my projects because of the wide variety of shielded cables available that match them. The case is 6"x6"x6", formerly black crackle finished, salvaged from my junk box (the whole garage), and resprayed red to cover the chips and rust spots.

Just one more thing on construction before we get to the good part. If I were to rebuild mine I would space my banana plug posts a standard ¾" apart; that way I could use standard dual banana jack instrument plugs. It doesn't affect anything; it's just a matter of looks. My Lucite plugs look rotten and it bugs me.

After I had completed the bridge I spent a couple of hours playing with it. I found it difficult to believe that such a simple device really worked so well. Finally I picked up an audio transformer with known impedances, and hooking one winding across the bridge and the output of my audio oscillator (set at 1 kHz) to the input, I adjusted the scope for a nice one inch trace. Try as I might, I could not get a reading anywhere near the impedance marked (in this case 10k Ohms). It suddenly occurred to me that the other winding should be loaded to its proper impedance in order to get an accurate reading on the winding under test. I quickly hooked up a four Ohm resistor to the output winding and, lo and behold, measured 10k Ohms on the primary. I then got myself a cup of coffee and sat down to do a little skull work.

As I sat sipping and pondering, it suddenly occurred to me that since four Ohms is a pretty low resistance, what would happen to the impedance of the other winding if I were to short the four Ohm winding? To think is to act, and I now measured approximately 1800 Ohms across the primary. Could it be that shorting the low impedance winding gives you a reading of about one fifth of the true impedance? Subsequent tests with other transformers show that, although this is not one hundred percent accurate, as a general rule of thumb you might use this as a ball park figure to start. Here is the procedure that I finally worked out.

Start by measuring the dc resistance of all windings with an ohmmeter (or with the bridge using the described procedure for dc resistance measurements) and marking them. If you are sure that it is an output transformer, hook a 4 or 5 Ohm resistor across the lowest resistance output winding. Connect the high resistance winding across the #5 and #6 terminals of the bridge, a 1 kHz signal to the input, and a suitable detector to the output. Measure the resistance and hook a carbon resistor of *this* value across the winding you have just measured. Reverse the transformer and measure the previously shunted low impedance winding. If it was an output transformer and you had used the 4-5 Ohm shunt, you will probably find that you are within 5-7% of the true value of the transformer. Close enough for all practical purposes.

If you are not sure of the type of transformer you are working with, proceed as follows. Short the leads of the lowest resistance winding together and connect the highest resistance winding across the bridge. Measure and multiply the reading you get by six and connect a resistance of that value across the winding that you just measured. Now reverse the transformer, measure the previously shorted winding, connect a resistor of that value across it, and repeat the procedure on the high impedance winding. It doesn't take but about two or three measurements, going back and forth from one winding to another, to achieve a remarkable degree of accuracy. Practice on a few transformers of known value and if you find your readings coming out wrong, look for shorted clip leads or open connections. With a little practice and care you can solve your unknown transformer problems.

Connect unknown inductor between 1 & 2

Range	Posts 3 & 4 Std. Res.	Posts 5 & 6 Std. Cap.
1 – 100 uH	1	.01 uF
10 – 1000 uH	10	.01 uF
100 uH – 10 mH	100	.01 uF
1 – 100 mH	1k	.01 uF
10 – 1,000 mH	10k	.01 uF
0.1 – 10 H	1k	1 uF
1 – 100 H	10k	1 uF

Table 2. Inductance Measurements.

Connect unknown capacitor between 3 & 4

Range	Std. Res. Posts 1 & 2	Std. Cap. Posts 5 & 6
1 – 100 pF	10k	.0001 uF
10 – 1000 pF	10k	.001 uF
100 pF – .01 uF	10k	.01 uF
.001 – .1 uF	1k	.01 uF
.01 – 1 uF	10k	1 uF
.1 – 10 uF	1k	1 uF
1 – 100 uF	100 Ohms	1 uF

Table 3. Capacitance Measurements.

It will interest you to know that you can also measure carbon and wire wound resistors to a very high degree of accuracy using dc current. First connect a source of dc, a battery or other supply of from 1½ to 4½ volts to the input jack with a push-button in series, and a 0-50 or 0-100 dc center scale micro-ammeter to the output jack. Hook the standards and the unknown up in accordance with the resistance chart. Using the push-button for momentary contact, start rotating the dial until you start to get a null, after which you can hold the button down to finalize the null.

Using an audio oscillator you can also measure capacitance and inductance as well as resistance. I've included the charts for these measurements also. Just remember to keep all test leads as short as possible, make tight connections, and be careful of shorts and open connections. For those of you who want to get involved in the more esoteric and/or mathematical use of this instrument, your public library has more than one engineering manual that will give you the dope on such elegant things as finding the power factor of capacitors, etc.

As for me, I just hook 'em up using the charts, tune for the best null I can get, and I'm happy with the results; but of course I'm just an old cut and try type. Try it; you'll like it. ■

1	1 Ohm res.	1	.0001 uF cap.
1	10 Ohm res.	1	.001 uF cap.
2	100 Ohm res.	1	.01 uF cap.
2	1k Ohm res.	1	1 uF cap.
2	10k Ohm res.		

Table 4. List of required standard resistors and capacitors, 1%.

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How Those Triangle Things Work

--a sort of op amp handbook

Definition of operational amplifier: one that works, as opposed to a non-operational amplifier; also known as that "triangle thing" on a schematic.

While not strictly accurate, the above definition is as good as any. While most of you have the idea that this triangular symbol represents some kind of amplifier, you may not be aware of how this thing called an op amp does its job. While, like any other amplifier, the function of an op amp is to create a large signal from a small one, the op amp has some special characteristics that need to be known in order to use it. With proper connections the op amp can become an amplifier of stable gain, an integrator, a voltage comparator, or function in almost any other way you can imagine (or glean from the application notes). The heart of all these things is an almost perfect, slightly temperamental but versatile building block.

Before we take a look at the real device, it might be interesting to look at a perfect amplifier. We'll start at the input. One of the most versatile input structures for an amplifier is the differential input. This has the ability to select those signals which appear different at each input while rejecting those signals that appear the same at each input. So the perfect amplifier has two inputs. Also, since the amplifier shouldn't load the preceding stage, the input impedance must be high. Since this is an imaginary amplifier we might as well make input impedance infinite.

Next, what about gain? Since we never know how much gain will be needed in a given application, an infinite gain amplifier should cover all possibilities. You might think that infinite gain would be difficult to control but, as you will see later, the gain can easily be modified by external circuitry. The next item to be considered is output impedance. In order to make sure the amplifier can drive any load, output impedance should be zero. And lastly, the amplifier output should respond instantaneously to any change in the input signal. This means that the bandwidth has to be infinite and the phase shift through the amplifier has to be zero. Our perfect amplifier is shown in Fig. 1.

As you have probably figured, real life operational amplifiers are not quite as perfect. Let's take as an example the UA709. Like our perfect amplifier, the 709 has two differential inputs: inverting and non-inverting. Input impedance is not quite infinite. In fact it is only about 250k Ohms. The voltage gain of this amplifier is quite high – somewhere around 50,000. To get 1 volt of signal output only 20 uV of input signal is needed. Output Z is in the order of 150 Ohms. The bandwidth of the amplifier is limited by internal circuit reactance to 1 to 2 MHz (Fig. 1).

It almost seems a little disappointing that the 709 turns out to be so far from ideal. Actually, the 709 is a fairly average op amp. Some devices approach the ideal more closely and some are worse. The reason the perfect amplifier was introduced was not to make all the real ones look bad, but to serve as a design model for all amplifiers. In most cases a real (imperfect) amplifier is treated as if it were perfect (see later).

Operational Amplifier Specifications

There are several specifications that are important to operational amplifiers. The first, A_{VOL}, has already been mentioned. This refers to the open loop or unmodified voltage gain of the amplifier. If you're looking over the specs of several amplifiers, you'll find that this specification usually is around 90 to 100 dB (30,000 to 100,000). In most applications the exact value is not important. What is important is that the gain is high.

Another important characteristic of op amps is their ability to reject signals that appear at both inputs at once. Remember with differential inputs the idea is to amplify the *difference* between the signals present at the two inputs. Any equal signals such as

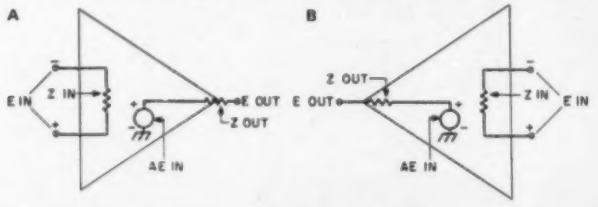


Fig. 1. Ideal (a) and typical (b) real amplifier. Ideal: A (gain) = ∞; bandwidth = ∞; Z_{IN} = ∞; Z_{OUT} = 0. Real: A = 100,000; bandwidth = 1 MHz; Z_{IN} = 250 kΩ; Z_{OUT} = 150Ω.

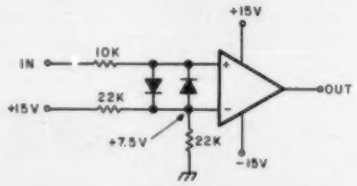


Fig. 2. Op amp used as comparator.

noise, hum or dc bias should have no effect on the output. The ability to reject these common signals is known as the common mode rejection ratio (CMRR) and is usually expressed in dB. It is simply the ratio of common signal to differential signal required to give the same output in either case. Most IC op amps achieve a CMRR of about 90 dB. This means that, in an open loop condition, if A_{VOL} is also 90 dB, differential signals will be amplified by 90 dB while common signals will be effectively amplified by only 0 dB (1). Like A_{VOL}, CMRR is very high in the typical op amp and can be treated in most cases as if it were perfect.

Let's shift away from the entire amplifier and take a look at the inputs of the common operational amplifier. Remember that the inputs of the mythical perfect amplifier were of infinite impedance. Of course the real amplifier doesn't quite make it. What's worse, the inputs are the bases of 2 separate (and therefore slightly different) transistors. A small but finite current must be injected into the bases of these transistors in order to turn them on. This current is, of course, called input bias current. And since the input transistors are slightly different, differing amounts of current are needed by each transistor to give the same effect. This current difference is known as offset current. Another type of offset occurs because of a slightly different reference level at each input. This is a voltage offset and in many op amps provision is made to adjust this out. In any case these offsets are small (typically 100 mA and 2 mV respectively) and are only of consequence when the amplifier is used in low input level situations. In situations where the input level is high in relation to the offsets, their effect is insignificant. But it should be recognized that those offsets exist and if the amplifier is to be expected to respond to low level signals, they must be dealt with.

As you probably are aware, not too many IC op amps perform well as 432 MHz amplifiers. As a matter of fact, most operational amplifiers are limited to an absolute maximum frequency of around 1 MHz. Some are not even good for high gain use as a hi-fi audio amplifier. This limitation is generally due to parasitic capacitance between circuit elements on the IC chip. Another more severe limitation is due to internal frequency compensation (see later).

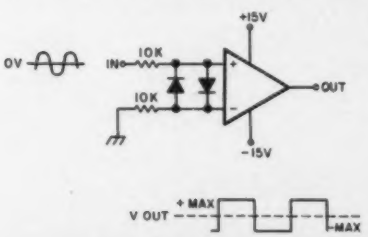


Fig. 3. 0 crossing detector.

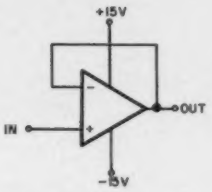


Fig. 4. Voltage follower.
$V_{IN} = V_{OUT}$.

Whatever the cause, op amps do not make good rf amplifiers, so their use is limited to the high audio range.

There are two bandwidth-related specifications that concern these amplifiers. The first is usually given in a graph as device gain versus frequency. The gain is usually flat from dc to some frequency at which point it starts to fall. The frequency at which the gain has dropped to 0 dB is called the unity gain crossover. At frequencies above this point the op amp becomes a very complicated and not too predictable resistor. The range between the start of fall off and the unity gain crossover is important to the stability of the amplifier and will be covered more fully later.

The other bandwidth-related specification deals with the ability of the output to change level rapidly. This is termed the slew rate and is given in V/uS. The higher the value of this specification, the faster the output voltage can change. You can see that since higher frequency signals change faster than those of low frequencies, the amplifier is less able to reproduce the high frequencies at high amplitude. The effect of slew rate is to make the bandwidth appear higher at low output levels than at high levels. This is not too great a problem unless you're trying to use the op amp as a power amplifier near its upper frequency limit.

How To Use 'Em

After going through the preceding section and learning how non-perfect IC op amps are, we are going to turn around and use them as if they were perfect. The why of the matter is two-fold. First (and most important), the IC is so close to perfect that the difference doesn't matter much. As an example, if we construct a voltage follower with a perfect amplifier (infinite gain) we would get 1.00000 . . . V out with 1.00000 . . . V input. With our non-perfect amplifier (gain = 100,000) 1.00000 . . . V input gives 0.999990 V out. That is only .001% error. Not bad, I would say. The second reason for calling our amplifier perfect is that circuit analysis becomes dirt simple.

Enough of this theoretical stuff. Let's see how these plastic (and/or metal) packages can be used.

One of the simplest ways to use the op amp is as a voltage comparator. With its high gain, a difference at the input of only a few millivolts produces full output. As shown in Fig. 2, a voltage divider (or a zener diode or some other stable voltage reference) places a fixed 7.5 V at the inverting input of the amplifier. Whenever the input voltage exceeds 7.5 V, the output swings to the positive limit. Whenever it is less than 7.5 V, the output swings to the negative limit. Of course the inverting and non-inverting inputs may be swapped if opposite output swings are desired. The only thing to remember is that the impedance seen by the two inputs should be about the same to minimize the effects of input bias current. This is desirable in any op amp circuit. The two diodes across the input only serve to limit the differential input. Some amplifiers behave strangely when their input becomes too great (like the inputs may self-destruct or the output may become the opposite of what it's supposed to or the output may latch in one state and forever thereafter ignore the input).

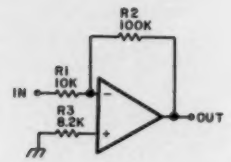


Fig. 5. Inverting amplifier.

$$\frac{V_{OUT}}{V_{IN}} = \frac{R2}{R1} = \frac{100k}{10k} = 10$$

Another circuit (really the same circuit but used differently) is the squarer or 0 crossing detector (Fig. 3). Whenever the input waveform exceeds ground potential, the output swings giving a rectangular wave output no matter what kind of input signal is present.

That is about all that can be done with the operational amplifier without some form of feedback. By adding appropriate feedback, the amplifier can be made to do many chores. The main advantage of feedback amplifiers is that the characteristics are controlled by the feedback network — the characteristics of the amplifier itself have little effect. That's why the real life amplifier can be regarded as perfect — the differences are almost completely cancelled by feedback.

Feedback Amplifiers

The first circuit to be introduced in this group is known as a voltage follower (see Fig. 4). The actual function of this circuit is of an impedance transformer. It will take a signal from a high Z source and duplicate it at a much lower impedance. Since there are no components other than the operational amplifier, the design procedure is quite simple. Simply connect the output back to the inverting input. To find out approximately what those input and output impedances are, a couple of simple formulas are used.

For input impedance find the values for A_{VOL} and differential Z_{IN} in the spec sheet and stick them in this formula: $Z_{IN} = (Z_{IN,DIFF})(A_{VOL})$. For the 709 this works

out to about 11 G Ohms. (Yes, gigaohms!)

For Z_{OUT} find output resistance and A_{VOL} in the spec sheet and use this formula:

$$Z_{OUT} = \frac{R_{out}}{A_{VOL}}$$

Again, for the 709, this works out to 3 milliohms. Do not be misled by this figure. This low output impedance is only apparent if the current driving capabilities of the amplifier are not exceeded. If high current outputs are required, a power amplifier should be connected to the output *within* the feedback loop.

The best figures for the above occur where the gain is highest (0 Hz). Note that as the frequency goes up and A_{VOL} drops off, both Z_{IN} and Z_{OUT} become less ideal. But for only one component and thousands of megohms of input impedance it's a pretty good circuit.

The principle used in designing this and other feedback amplifiers is to regard the amplifier as perfect – that is, having infinite gain and infinite input impedance. If the amplifier has infinite gain the only way we can get a finite voltage at the output is with

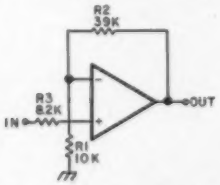


Fig. 6. Non-inverting amplifier.

$$\frac{V_{OUT}}{V_{IN}} = \frac{R1+R2}{R1} =$$

$$\frac{10k+39k}{10k} = \frac{49k}{10k} = 4.9.$$

0 volts differential input. With the amplifier connected in a negative feedback configuration, the output will increase until its effects become equal to, and effectively cancel, the input voltage (at the non-inverting input). The principle of the feedback cancelling the input is used to design all feedback amplifiers using high gain op amps – the output stabilizes at a level that reduces the differential input to zero.

If you really want to do more with the signal than duplicate it, you can place some resistors in the feedback loop and give the amplifier any gain desired. The first of two amplifier circuits is shown in Fig. 5. This circuit inverts all signals applied to its input. The gain of this circuit can be computed:

$$A_V = -\frac{R2}{R1}$$

(the – indicates an inversion has taken place). Mathematically, this works out very simply. Since the inverting (–) input is held at 0 V (or some other constant set by the voltage at the non-inverting input), R1 and R2 form a voltage divider whose center

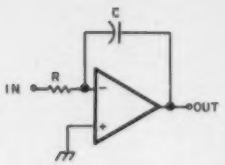


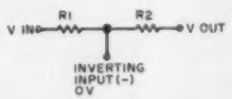
Fig. 7. Op amp integrator (see text).

point is at 0 V. Also since the input impedance is supposed to be infinite, the current through R1 is equal to the current through R2:

$$I_{R1} = -I_{R2}$$

$$\text{or} \quad \frac{V_{IN}}{R1} = -\frac{V_{OUT}}{R2}$$

$$\text{or} \quad \frac{V_{OUT}}{V_{IN}} \text{ (voltage gain)} = -\frac{R2}{R1}$$



Remember that this simple math is only for the perfect amplifier: infinite gain and zero current injected into or sunk from the inputs. R3, I'm sorry to say, is used to compensate for one of the amplifier's imperfections – the current used by the inputs to bias themselves on. Its value (R3) is usually equal to the parallel value of R1 and R2. The idea is that both inputs should see the same impedance to minimize the effect of input bias current. If the input bias current is much less (less than 5%) than the feedback network current, R3 is not really necessary.

The second type of feedback amplifier is the non-inverting type (the voltage follower is a special case of this type; see Fig. 6). Once again, by placing resistors in the feedback loop and input we can tailor the gain to any value. In this circuit R3 has the same function as in the inverting amplifier . . . R1 and R2 are the gain control elements, and by making the same assumptions as for the inverting amplifier, we can see that the currents are equal in both resistors and their common point is held at V_{IN}. The math goes like this:

$$I_{R_2} = I_{R_1}$$

$$\text{or} \quad \frac{V_{OUT} - V_{IN}}{R_2} = \frac{V_{IN}}{R_1}$$

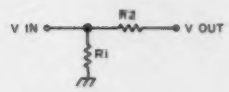
$$\text{or} \quad R_1 V_{OUT} - R_1 V_{IN} = V_{IN} R_2$$

$$\text{or} \quad R_1 V_{OUT} = V_{IN} R_2 + V_{IN} R_1$$

$$\text{or} \quad R_1 V_{OUT} = V_{IN} (R_1 + R_2)$$

$$\text{Finally,} \quad \frac{V_{OUT}*}{V_{IN}} = \frac{R_1 + R_2}{R_1}$$

*Voltage Gain.



Input and output impedances of these last two circuits are fairly easy to estimate. The method is nearly the same as for the voltage follower circuit. The only difference is that these impedances are not improved by the full A_{VOL}. Since we "used" some of the gain of the amplifier to increase the amplitude of the input signal, that "used" portion must be deleted from the total A_{VOL}. What's left is referred to as loop gain:

$$\frac{A_{VOL}}{AFB} = A_{LOOP}$$

A_{LOOP} is used just like A_{VOL} was previously:

$$Z_{IN} = (Z_{DIFF})(A_{LOOP}) \text{ and } Z_{out} = \frac{R_{out}}{A_{LOOP}}$$

Any impedances in series with the amplifier terminals have to be added to the computed impedance. This usually makes no difference to the input but can change the output considerably.

Non-Linear Feedback

You have seen how placing resistors in the feedback path can affect amplifier characteristics. Now what would be the effect of a capacitor stuck in the feedback path? Let's start with the circuit shown in Fig. 7. This, as you notice, is very similar to the inverting amplifier shown previously, except for the substitution of C for R2. And also the gain formula originates in the same way. This is going to be a little more complicated since putting a capacitor in there tells us there is going to be a time factor. Let's give it a try: The currents through C and R must be equal since their junction is at a high Z fixed voltage point. So: $I_C = -I_R$

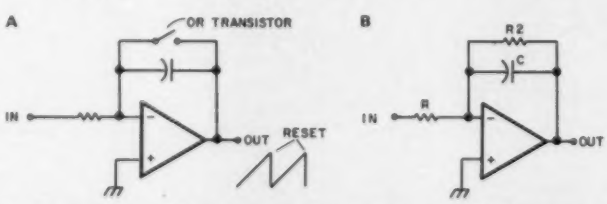


Fig. 8. Integrator modification to correct for offset drift. (a) Ramp generator application. (b) AC application – leaky integrator.

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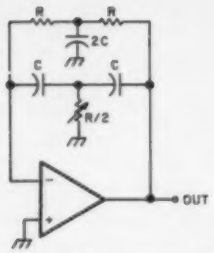


Fig. 9. Twin T sine wave oscillator. $f_{OUT} = \frac{1}{2\pi RC}$. *R/2 adjusted until circuit just oscillates.*

We seem to have run into trouble right away since it's hard to give a resistance value to a capacitor. But luckily:

$$I_C = \frac{C \cdot E}{t}$$ (C in farads, E in volts, t in seconds)

Sticking that in the formula,

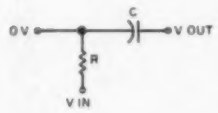
$$\frac{C \cdot V_{OUT}}{t} = -I_R = -\frac{-V_{IN}}{R}$$

Now we're getting somewhere. The gain is then:

$$\frac{V_{OUT}}{-V_{IN}} = \frac{t}{RC}$$

You may be wondering what that's supposed to mean. Not much as it stands, but change a few terms around and:

$$V_{OUT} = \frac{t(-V_{IN})}{RC}$$



With any given components (R and C) and with a given input (V_{IN})(hold them all constant), V_{OUT} will increase linearly with time (a ramp generator!). Increasing the RC product will lower V_{OUT} in a given time or will increase time for a given V_{OUT}. By reversing the polarity or amplitude of V_{IN} the direction and slope of the output can easily be controlled.

This circuit is generally known as an integrator and functions the same as an RC integrator except that the circuit (with the op amp) has the advantage of linear operation, higher Z_{IN}, low output impedance and voltage gain.

If the gain of this circuit is plotted versus frequency, it will be seen that the gain is infinite (or A_{VOL}) at dc and then begins to drop off 6 dB per octave starting at a point determined by R and C. The frequency is actually:

$$\frac{1}{2\pi RC}$$

Looking at it this way, this circuit turns out to be a low pass filter. By placing appropriately frequency sensitive components in the feedback network almost any response can be generated. This is the basis of active filters which have been adequately covered in a previous article[1]. Anyone interested in active filters should read that article.

If you want to try an op amp integrator there is a practical problem that should be mentioned. If the circuit of Fig. 7 is used as is, the output will tend to drift toward maximum in one direction or the other. This is because the circuit will continue to integrate any offset error at the input even with the input grounded. This problem can be eliminated when using the circuit as a ramp generator by resetting the circuit at the end of each ramp with a switch or transistor across the capacitor (Fig. 8a). Closing the switch causes the output to return to whatever input appears at the non-inverting input (in this case zero). The switch is then opened when you want to start integrating again.

When integrating an ac signal, special arrangements must be made since integration must be continuous. One thing you could do is to synchronize the input to the integrator output. When the output reaches some maximum level, the input should change to run the integrator output in the opposite direction. The only use for this method I've seen is for a type of oscillator.

The most practical method of using an op amp integrator with an ac input signal is shown in Fig. 8b. An extra resistor, R2, is added. This resistor provides enough feedback current to cancel any error at the input. Of course, this simple solution does have its problems. The gain and frequency range of integration are reduced by some degree and the operation performed by the circuit is not a true integration. But these effects are relatively minor so this circuit should work well in most situations. The circuit is known, appropriately, as a leaky integrator.

Another area of non-linear feedback circuits is that of oscillators. Oscillators differ from the previously described amplifiers in that they use *positive* feedback. How that feedback is handled determines the type of oscillator and the type of output. Actually, any type of oscillator can

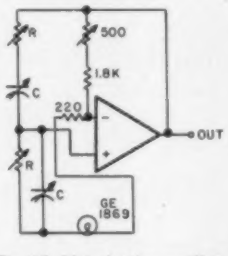


Fig. 10. Wein bridge oscillator.

$$f_{OUT} = \frac{1}{2\pi RC}$$

be implemented using op amps. The trick is to combine a gain element (the op amp) and some sort of frequency sensitive phase shift element. A few examples follow with not much math.

Sine Oscillators: Sine wave oscillators using operational amplifiers are very similar to discrete oscillators except that the op amp is the active element. The first shown is known as a twin T or double integrator Oscillator. [Note: An integrator provides a 90° phase shift to a signal at the frequency:

$$f = \frac{1}{2\pi RC}$$

The double integrator ought to (and does) provide a 180° phase shift at that frequency. The RC network provides 180° phase shift at the oscillation frequency (see Fig. 9). An interesting feature of this circuit is that if R/2 is adjusted so that the circuit just does *not* oscillate, you have a narrow bandpass filter. Apply the input through a resistor to the (–) input.

Another sine oscillator is the famous Wein Bridge, shown in Fig. 10. The output is a very low distortion sine wave.

Square Wave Oscillators: A simple multivibrator type circuit which generates a

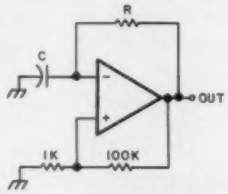


Fig. 11. Square wave oscillator.

$$f_{OUT} = \frac{1}{2\pi RC}$$

square wave is shown in Fig. 11. The output will alternately switch from full positive output to full negative output.

Another oscillator that produces a square wave also generates a linear ramp triangle wave. It consists of one op amp wired as an integrator while the other is wired as a comparator whose reference changes according to the slope of the integrator output. This circuit is commonly used as the basic oscillator in function generators[2]. See Fig. 12.

In this section I've tried to show in a general way how the operational amplifier functions in a circuit. These examples are by no means all that can be done with these amplifiers. Manufacturers' data books and application notes are full of additional information. With a little experimenting and simple design work it shouldn't be too difficult to think of a few applications of your own. Before you start, there is one more thing you should be aware of.

Compensation

While most operational amplifiers used today have no need for compensation (they are already internally compensated), there

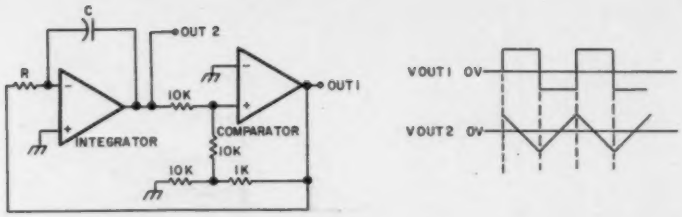


Fig. 12. Simultaneous square and triangle wave generator. $f_{OUT} \approx \frac{0.55}{RC}$

are some applications where it is necessary to use an uncompensated amplifier and do the compensation yourself.

First we must determine what compensation is and why it is necessary. Unlike the perfect amplifier, our op amp has a limited bandwidth. At some high frequency point the response (gain) tends to fall off. Without compensation the rate of fall off is usually quite fast. When the op amp is used as a feedback amplifier, there is a point where the open loop gain equals the closed loop gain. If the open loop gain at this point falls off too fast, the circuit may oscillate at that frequency. The only way to avoid instability or oscillation is to make sure that the rate of open loop gain fall off is 6 dB/octave or less at the crossover point. That is the function of compensation – causing the gain of an amplifier to fall off in a predictable way to prevent instability.

An internally compensated amplifier is adjusted so that the gain starts falling off at 6 dB/octave (20 dB/decade) at about 2 Hz. The voltage gain drops to 0 dB at 1 MHz (for the 741). While this guarantees that the amplifier will be stable under any conditions, it limits the gain severely at high frequencies. To obtain high gain at high frequencies an uncompensated amplifier has to be custom compensated to begin the 6 dB/octave fall off at some higher frequency. The instructions for compensation are usually contained in the manufacturer's specification sheet. For example, a UA709 can be compensated for 60 dB gain up to 500 kHz while the internally compensated UA741 would only be good for a marginal 10 dB voltage gain at that frequency. Internal compensation is only there for convenience; there are some advantages to non-compensated op amps. Some common uncompensated types are UA709, LM301 and LM308. Compensated types include UA741, 5558 and LM307.

Some Other Amplifiers

This entire discussion so far has concerned common op amps of the 709-741 variety. These have bipolar transistor input and are voltage controlled voltage output devices and usually require a balanced power supply. But the IC industry has definitely not stopped there. There are amplifiers with high slew rate outputs (531), Darlington transistor inputs (LM316), FET inputs (536), single supply requirements (LM324 – this device also boasts four amplifiers in one package), and even some that require very low power (533). While some of these have some fairly special characteristics, they operate much the same as the old 709.

There are other type amplifiers that don't operate exactly like an op amp. RCA has a family of devices called transconductance amplifiers. This means they are voltage controlled, *current* output devices. What they've come up with is a high gain, differential input, solid state vacuum tube (or FET). Regretfully, I have no information about them so I can't give any definite applications.

Another interesting device (which I happen to know something about) is the LM3900. These would be called operational amplifiers except that this device amplifies the difference in the *currents* into the inputs. The currents required are fairly small (usually around 10 uA), so large value resistors in series with the inputs can turn this into a voltage amplifier if that is necessary. Positive features of this device (according to National Semiconductor) include its ability to operate with either single or bipolar supplies, a large output voltage swing, a fairly wide bandwidth even with internal compensation and its low cost (there are four amplifiers to a package for less than 60¢).

A few typical applications are shown in Fig. 13. For more information contact National Semiconductor[3]. Their data sheet includes several pages of applications for this device. The spec sheet says these devices are designed primarily to produce ac amplifiers, RC active filters, low frequency waveform generators, tachometers, or low frequency, high voltage logic elements. Try your hand at some of them or adapt some regular op amp circuits. Remember, this device can also be treated as a perfect amplifier except that the inputs are controlled by current, not by voltage as in a normal op amp.

In this article I've tried to give a broad outline of the whys and wherefores of operational amplifiers. While this is nowhere near all there is to say about op amps, it is hoped that those triangular symbols are now less of a mystery. Go through this magazine and see if you can analyze the operation of any op amps used in other articles (my luck, this is an antenna issue or something). For more information Motorola[4] publishes several application notes: AN-204 – "High performance Integrated Operational Amplifiers," AN439 – "MC1539 Op Amp and its Applications," and AN-522 – "The MC1556 Operational Amplifier." If you have access to a technical library, Burr-Brown (a well established op amp manufacturer) publishes a book (*Operational Amplifiers*) that contains all the information you would want. Manufacturers' spec sheets will also contain a great deal of information. The more information you have and use (and hopefully this article was of some help), the less mysterious those "triangle things" can become. ■

References

[1]Williams, "Active Filter Design and Use, Pt. III," *73 Magazine*, Sept. 1972, p. 76.

[2]Olsen, "Build This Amazing Function Generator," *73 Magazine*, Aug. 1975, p. 121.

[3]National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051.

[4]Motorola Semiconductor Products, PO Box 20924, Phoenix AZ 85036.

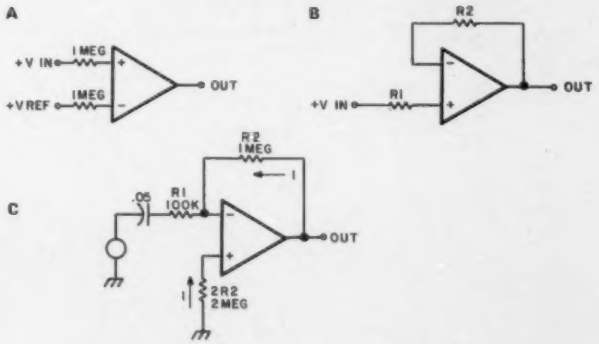


Fig. 13. LM3900 circuits. (a) Voltage comparator. (b) Non-inverting DC amp; $\frac{V_{OUT}}{V_{IN}} = \frac{R2}{RI}$. *(c) Inverting AC amplifier;* $V_{OUT(DC)} = \frac{V+}{2}$;

$A_{V(AC)} = \frac{R2}{RI} = 10.$

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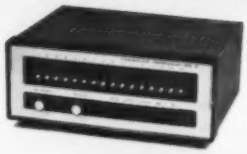

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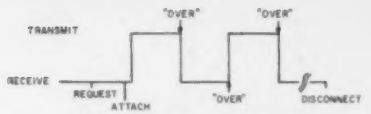

Fig. 1. Base station running manual patch. Keyword "OVER" triggers switching between transmit and receive.

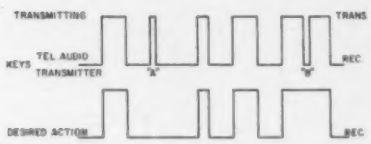

Fig. 2. Base station running manual-VOX patch. Telephone audio controls transmitter, sporadic noise causes false keying at "A" and hesitation causes premature dropout at "B."

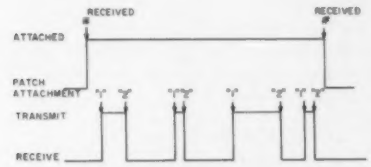

Fig. 3. Base station equipped with automanual patch. Called party transmits two control tones – one to start the transmitter ("1"), and another to stop transmitting ("2").

Phone Patching '76

-- automatic single frequency patch

Phone patches have been popular for many years, and the advent of repeater systems spawned a new age of phone-in-the-car enthusiasts. Many VHF and UHF repeaters have automatic telephone patches, i.e., autopatches. The telephone service is an easily added system feature and renders hours of enjoyment and a potential for substantial public service.

There are those among us who have become so fascinated with the autopatches that they are an end in themselves. That is, the underlying motivation for building a repeater is the promise of mobile telephone service. We all know about not being allowed to use these systems for commercial purposes, but there are many non-commercial applications that are both fun and of significant public service. Applications range from receiving shopping lists from home to reporting traffic mishaps, fallen power lines, etc.

The conventional autopatches, so frequently an integral part of repeaters, are characteristically half-duplex devices. This means you can either talk or listen, but not both at the same time. The common HF phone patches are typical of this mode of communication. For a full-duplex patch you would need to simultaneously receive and transmit. This would require the mobile transmitter and receiver to be operating at the same time. For most amateurs, this would pose significant technical problems, not the least of which would include an additional antenna or some type of diplexer to use a single mobile antenna. The telephone company has already perfected this mode of operation. Of course, the full-duplex approach uses two radio frequencies (one for transmit and one for receive) and provides "realistic" telephone service – you can do all the things characteristic of telephone conversations – butt in, insert lots of "uh-huhs," etc!

For casual amateur purposes, it may not be necessary or practical to worry about full-duplex service. But if half-duplex service is adequate, then why utilize two valuable radio channels? Why not use repeaters to extend the range of reliable communications and single frequency telephone systems to provide half-duplex telephone service? At least this is a nice technical thing to think about even if telephone-only systems might cause the FCC to experience a new set of amateur problems. After all, what is a fully automatic base station that renders telephone service? It's certainly not a repeater for it doesn't repeat. It's not a remote base for it never functions as a base for the mobile user – or does it? Well, anyway, let's continue the technical considerations.

Types of Single Frequency Phone Patch Systems

Several types of single frequency phone patch systems can be considered and then discussed in turn:

1. Manual phone patch
2. Manual-VOX phone patch
3. Automanual phone patch
4. Autovox phone patch
5. Time division phone patch

The following discussion will demonstrate that all of these systems are practical and that the last three are capable of providing fully automatic (autopatch) service on a single radio channel.

Manual Phone Patch

A manual phone patch is typified by the many phone patches operated on the HF bands. The phone patch is manually attached to the telephone line by the base station operator and the transmitting and receiving periods are likewise controlled by the base station operator. Typically, the operator responds to the keyword "OVER" which causes him to reverse the transmit/receive mode. If you've ever run such a patch for people not speaking your native language, you know the confusion that can result if you don't hear "OVER." The manual patch provides half-duplex service and uses only one radio frequency (assuming the two stations are "netted). Fig. 1 shows a typical activity sequence.

Manual-VOX Phone Patch

The manual-VOX phone patch is a relatively simple extension of the manual patch. Again, the base station operator manually

attaches the phone patch to the telephone line. In this system, a VOX circuit detects the telephone party's speech and in turn, keys the transmitter. Again, the keyword "OVER" is sometimes valuable to enhance coordination between the telephone party and the distant radio user. At least in this system, the radio operator is not needed to accomplish the individual transmit/receive actions – a level of automation has been accomplished. This patch provides half-duplex service and uses only one radio frequency. Fig. 2 shows a typical activity sequence.

Automanual Phone Patch

An automanual phone patch does not require a base station operator. The phone patch is attached to the telephone line upon receipt of a command from the radio user. The user simply transmits a special audio tone which is detected at the base station receiver. Once the patch is attached, the radio party transmits additional tones which are used to accomplish the number dialing (previously done by the base station operator). The base station control circuitry causes an identifying tone to be applied to the telephone line so that when the called party answers he can identify the fact that he is receiving a call from a radio user. This causes the called party (assuming he's been so instructed) to request use of the transmitter by sending a control tone – e.g., Touchtone "1". He likewise marks the end of his transmit period with a control character – e.g., Touchtone "2". When the telephone call has been completed, the patch is disconnected from the telephone line in one of two ways:

1. A circuit detecting the fact that the called party has placed his handset "on-hook" generates a disconnect signal; or
2. A control tone is sent by the radio user.

This system is semiautomatic – the phone patch is attached and released without a base station operator intervening. However, the switching between transmit and receive is controlled by the telephone party – a less than ideal situation since many people called may not be trained or equipped to perform this function. If you intended to always call telephones manned by appropriately trained people and equipped for this type of operation, then this simple system would render a pseudo-autopatch service in a reasonable way. It is automatic, half-duplex, and uses a single frequency. Fig. 3 shows a typical activity sequence.

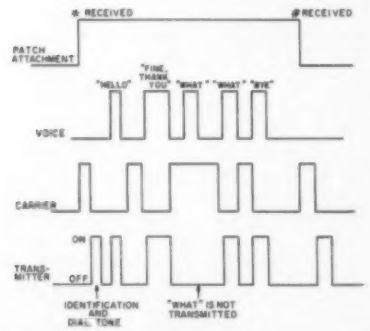

Fig. 4. Base station equipped with autovox patch. Note how first "What?" isn't transmitted – VOX is inhibited when a carrier is present.

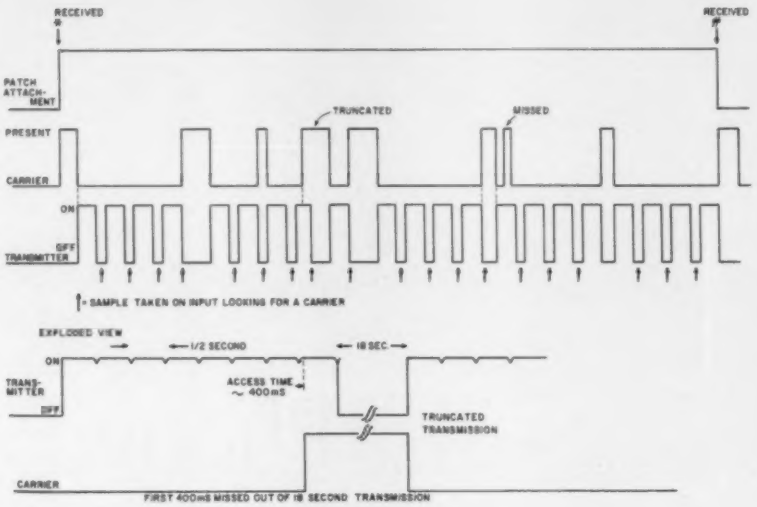

Fig. 5. Time division patch.

This system poses very interesting legal questions. The typically unlicensed telephone party controls the transmitter via special actions – namely transmitting control tones. Think for a moment about a telephone handset equipped with a PTT button (such things exist). Now consider a "beeper" circuit that generates one audio signal when the button is depressed and another when the button is released. The called party now looks very similar to a normal radio operator. Who's really in control of the transmitter? At least *at times* it's probably the telephone party with the transceiver functioning as his remote base station! Other systems exhibit this same problem – the time division patch (to be described later) solves this problem.

Autovox Phone Patch

An autovox phone patch is the logical extension to the automanual phone patch. Again, control tones from the radio user are used to attach and release the phone patch. However, the periods of transmit and receive are basically controlled by the telephone party's speech. This system allows the radio party to render all of the significant control functions while enabling the called party to initiate the transmit and receive periods without needing special equipment or instructions. This patch is fully automatic and renders half-duplex telephone service on a single frequency. Fig. 4 shows a typical activity sequence.

Time Division Phone Patch

The time division phone patch derives its name from the fact that the base station control logic divides the transmit time into periods of transmission *and* reception. During very brief receive periods that take place during interruptions to the normal transmit activity, the system receiver is able to detect the user's incident carrier and therefore cease transmitting and enter a prolonged receive period. This patch introduces additional technical complexities to the base station (no changes to mobile users), but renders better service in that the radio

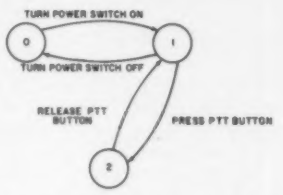

Fig. 6. Fundamental state diagram.

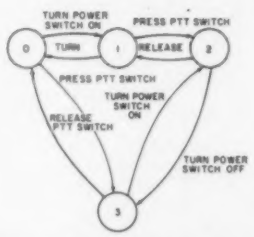

Fig. 7. Transceiver state diagram.

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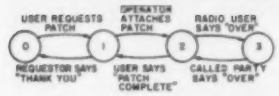
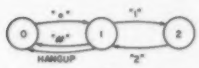


A

B



C

STATE	SIGNIFICANCE
0	Idle
1	Patch attached, base station receiving
2	Patch attached, base station transmitting

*Fig. 8. User attaches patch via *, releases via #, auto-release via called party hanging up. Digit "1" means start transmitting and digit "2" means start receiving.*

user is in full control of the system (unlike *any* of the other systems wherein the user is at the mercy of the base station operator, a telephone user, or a VOX circuit). The time division phone patch is fully automatic, renders half-duplex telephone service, and uses a single frequency while enabling total radio party control. Fig. 5 shows a typical activity sequence.

Practical Considerations

Each of these systems has its strong and weak points – some require a base station operator, some do not, some require sophisticated control logic and some do not. You can't have your cake and eat it too! However, all of these systems will work. Most of us are quite familiar with the first two systems having either built patches, used patches, or been served by patches. The others are less well known. The automanual patch, while relatively simple, has extremely limited usefulness, and so it's not very interesting for general application. The autovox patch and time division patch are quite workable and worthy of further study.

State Diagrams

State diagrams are a popular graphic convention used in the fields of electrical engineering and computer language processing. State diagrams are a helpful aid to understanding complex event sequences. Following a brief description of state diagrams, each of the patch systems will be described and discussed using this graphic convention. It is then possible to build appropriate control circuits to in effect "implement" the state diagrams.

The idea of a "state" needs to be understood before continuing. A state is representative of a particular *condition.* For example, a 2 digit binary counter has four states – 00, 01, 10, 11. The counter can be in any one of these "states"; i.e., the counter's "condition" is that it contains 00, 01, 10 or 11 as the count. A state diagram consists of a series of circles containing numbers indicative of a particular state. The circles are connected by lines showing what stimulus causes a *transition* from one state to another state. Fig. 6 shows a simple state diagram that describes the operation of a typical mobile transceiver.

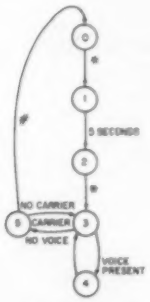
The system has three states – named state 0, state 1 and state 2. State 0 is characterized by no activity, state 1 is the receive state, and state 2 is the transmit state. Note that the state diagram shows what happens to the system as a function of various actions. Note that the amount of detail shown is a function of the clarity you wish to show. Fig. 7 shows a further enhancement of the transceiver state diagram. Note how this completely describes the system – there are *four* states – 0 through 3. There are two primary controls: the power switch and the PTT button. Both of these switches have two positions – ON and OFF. A truth table shows these combinations:

STATE	PTT	POWER	
0	0	0	0 means switch "off"
1	0	1	1 means switch "on"
2	1	1	
3	1	0	

Specific State Diagrams and System Descriptions

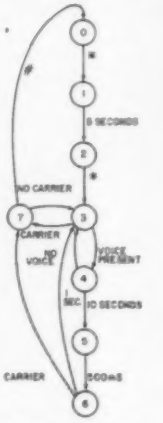
Figs. 8(a), 8(b) and 8(c) show state diagrams for the first three phone patch systems discussed. Figs. 9(a) through 9(c) show state diagrams for an autovox patch.

Fig. 9(a) describes a very simple autovox



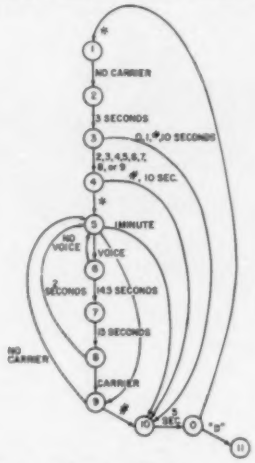
STATE	SIGNIFICANCE
0	Idle
1	Attach patch, key transmitter to broadcast dial tone
2	Receiving dialing information
3	VOX mode of transmitter control
4	Key transmitter and broadcast telephone party's voice
5	Inhibit transmitter and stay in receive mode

Fig. 9(a). Simple autovox system.



STATE	SIGNIFICANCE
0	Idle
1	Attach patch, key transmitter to broadcast dial tone
2	Receive dialing instructions
3	VOX mode of transmitter control
4	Key transmitter and broadcast telephone party's voice
5	Generate "beep" to inform user of control period
6	Receive period to allow user to "grab" control
7	Inhibit transmitter and stay in receive mode

Fig. 9(b). Improved autovox system.



STATE	SIGNIFICANCE
0	Idle
1	Attach patch
2	Key transmitter to broadcast dial tone
3	Accept dialing information
4	Accept non-toll number
5	VOX mode of transmitter control
6	Key transmitter and broadcast telephone party's voice
7	Broadcast "beep" tone
8	Receive period to allow user to "grab" control
9	Inhibit transmitter and remain in receive mode
10	Initiate concluding identification sequence
11	System deactivated

Fig. 9(c). A practical autovox system.

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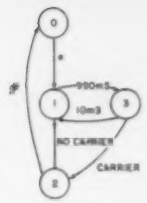


STATE	SIGNIFICANCE
0	Idle
1	Attach patch, key transmitter
2	Inhibit transmitter, stay in receive mode
3	Inhibit transmitter, activate receiver

Fig. 10(a). Simple time division patch system.

One sample taken every:	Length of sample (ms)	QUALITY Poor	Fair	Good	Excellent	Essentially Unnoticeable	% Transmitted
1 sec	50				X		95
2 sec	50					X	97.5
2 sec	100		X				95
1 sec	75			X			92.5
2 sec	75					X	96.25
1 sec	58				X		94.2
.5 sec	58			X			88.4
1 sec	42				X		95.8
2 sec	42					X	97.9
3 sec	42					X	98.6
3 sec	100		X				96.7
5 sec	150		X				97
5 sec	42					X	99
.5 sec	42		X				91.6

Fig. 10(b).

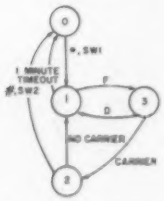


Fig. 10(c). A practical time division patch system.

patch system. A user transmits a "*" to activate the system. The system immediately responds by attaching the patch and keying the transmitter to broadcast the dial tone. A normal VOX circuit would continue to key the transmitter due to the presence of the dial tone. The control logic includes a five second timeout to keep this from happening. State 2 is a receive only state and during this period the user transmits number dialing information – either via a rotary dial or Touchtone pad. The user marks the end of the dialing activity by sending a *. State 3 is a general receive state. If the user transmits a signal, the control logic goes to state 5 where voice on the phone line is ignored (the radio user has control). If voice is detected during state 3, then state 4 is entered and the transmitter is keyed to broadcast the telephone party's voice. When there is no more voice present, state 3 is reentered. The patch is disconnected when a # is received in state 5 – user is in control and transmits a #. Note that the user cannot get control when the system is in state 4. The base station transceiver is not receiving! Several improvements can be made to this system.

Fig. 9(b) describes a better autovox patch system. In this system, three additional states have been added to allow the mobile an opportunity to gain periodic control.

If voice persists for 10 seconds (system stays in state 4 for 10 seconds), then state 5 is entered. State 5 causes the transmitter to be turned on and an "alerting audio tone" is applied to the transmitter's input. After 500 ms of this tone, state 6 is entered for a maximum of 1 second. If the mobile user keys his transmitter, the resulting carrier will cause state 7 to be entered wherein the user can talk to the telephone party and/or transmit a control character such as # to disconnect the patch. This type of control logic enables the system to accommodate situations such as an over-sensitive VOX circuit, a long-winded telephone party, or a call to a telephone located in a very noisy area. The voice and carrier signals are mutually exclusive in that the presence of a radio signal causes the voice signal to be ignored and a voice signal causes a radio signal to be ignored – in fact "missed" since the transmitter is then on and the receiver is then off.

Additional improvements can be made through the addition of timers and escape paths. Fig. 9(c) shows the state diagram of a good, workable autovox patch system. (This logic has been fully implemented using T^2L logic to control a 2 meter autovox system.) Several significant features have been added to the system shown in Fig. 9(b). A minor improvement consists of introducing a state to keep the autopatch system from QRMing the user at start-up time (state 2 is not entered until the carrier that presented the * has ceased). States are also included to "block" toll calls. When the dialing state is entered (state 3), an initial 0 or 1 will abort the control sequence. Note also that the system only provides 10 seconds for the first valid digit. The user may also deliberately abort the control sequence by sending a #. It is thus possible to "test" the system by transmitting a * and then a #. Receipt of a valid first digit (2, 3, 4, 5, 6, 7, 8 or 9) causes state 4 to be entered. In this state the additional digits composing the telephone number are "dialed." If an error is made, a # may be used to exit the control sequence. If the user is too slow, or if his signal fades out, a 10 second timer aborts the control sequence. The end of dialing information is indicated by the user transmitting a * which moves control to state 5. States 5, 6, 7, 8 and 9 function the same as states 3, 4, 5, 6 and 7 in Fig. 9(b). State 10 is added to serve as a terminal state which initiates an identification sequence. In fact, in the actual implementation, an identification sequence was initiated upon entry into state 3, at periodic intervals during use, and upon entry into state 10. State 11 can be entered by sending a "D" to "kill" the system – theoretically "pulling the plug." The 1 minute timer associated with state 5 causes the system to abort if there is no activity for a period of 1 minute – no activity being no signal received and no voice on the telephone line. In addition, a call length timer is associated with the system being in any state other than state 0; to allow for longer telephone calls, the user can reset this timer by sending a "D" character.

There are two significant weaknesses in the autovox patch system. First, the radio user can only grab control in particular states – 5 and 8 in Fig. 9(c). This limits the user's ability to inhibit a runaway system or censor an over-excited telephone user. The second weakness is in the use of a VOX circuit. Reliable VOX circuits are a rarity unless they become rather sophisticated electronically. On the other hand, the system is fully automatic, uses only a single frequency, and provides reliable service when properly adjusted.

Fig. 10(a) describes a simple time division patch system. While the state diagram is simple, the system is quite impressive in terms of its operational characteristics. Upon receipt of the access control

character, a *, the system attaches the patch. The transmitter is keyed whenever the system is in state 1. For the sake of simplifying the discussion, assume for the moment that a carrier is not received. In this situation, state 3 is entered after the system has been in state 1 for 990 ms. State 3 is left after 10 ms. The system thus cycles between states 1 and 3 – staying in state 1 most of the time – in fact 99% of the time. (Note: Time is divided between transmitting and receiving – thus the term time division.) In state 1, the patch is attached and the transmitter is keyed; in state 3 the receiver is on and the transmitter is off. Consequently 99% of the telephone party's audio signal will be transmitted. Now, consider the effect of an incident carrier. If a signal is detected during the 10 ms time period that the receiver is active (via state 3), then state 2 is entered and the receiver remains activated (and the transmitter disabled) until the incident signal ceases, thereby causing state 1 to be entered. Since the receive state is entered approximately once every second, the *average* time needed for the system to detect a mobile user's signal is ½ second. From the user's point of view, this means that when he starts to transmit, his voice will be heard on the phone line within a maximum of 1 second – ½ second on the average. Actually, his signal will be detected within 0 to 990 ms; sometimes it will be detected immediately, other times not nearly so quickly.

The radio user will not receive all of the telephone audio – only 99% of it. Careful studies have been made to determine the effect of "missing audio" on the listener's ability to understand the information being transmitted. There are three principle factors:

1. How often the signal is interrupted;
2. How long the interruption lasts;
3. What replaces the missing signal.

Fig. 10(b) summarizes the author's subjective evaluation of an experiment performed by Chuck Fenwick WØFTM. The interruption rate and interrupt duration were varied while the same speaker read the same text at the same rate. The missing sections were replaced with silence.

In an operational time division autopatch system, the missing information would probably not be replaced with a zero signal. If VHF-FM is used, the lack of a signal produces a hissing sound; if AM is used, the lack of a signal is generally quiet, but certainly not totally quiet; other modes would have other characteristics.

Several practical considerations must be made in a time division patch system. The frequency of entering the receive state and the duration within the receive state must be carefully chosen. Ideally, you want to enter the receive state frequently and stay as short a time as possible. Entering frequently enables the user to gain access quickly; staying a short time minimizes the loss of information transmitted from the phone line

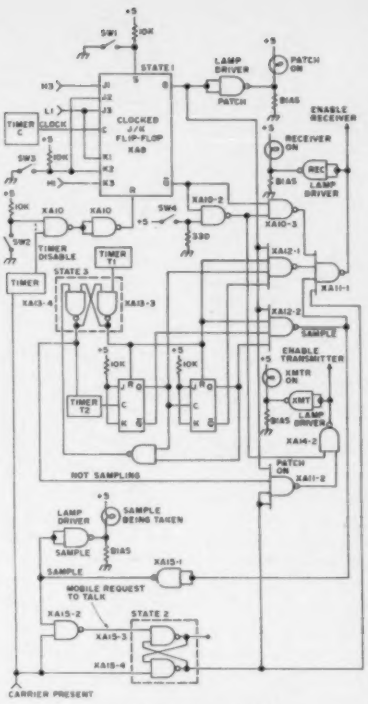


Fig. 11. Control logic.

due to the deactivated transmitter. A practical limit results from the inability to stop transmitting instantly and start receiving instantly. Even if this were possible, the speed of the carrier detection circuit must be considered. The operation is smooth when the frequency of interruption is a second or less and the duration is limited to a few milliseconds.

Fig. 10(c) describes a practical time division patch system which I have built and operated. The patch is activated by the * character or a depression of switch SW1. The system is deactivated by the #, or a 1 minute timeout (no carrier for 1 minute), or a depression of switch SW2.

An Operational Autovox System on 2 Meter FM

The autovox system described in Fig. 9(c) was implemented on a series of circuit cards using surplus T^2L logic components. One significant comment can be made about the implementation: It could have been better! The initial temptation is to view each state on the state diagram as a memory element – i.e., a flip flop. This approach results in 12 flip flops – one for each of the states 0-11. However, each flip flop has two states – either set or reset. If there are twelve flip flops, each of which can have two states, the system can theoretically assume any one of 2^{12} states! (Two flip flops can assume four states – 00, 01, 10 and 11, three flip flops can assume eight states, and twelve flip flops can assume 4096 states!) But, out of these, only twelve states are valid. A better implementation can be made by using a four-bit counter which can assume 16 states – 0 through 15. The logic that one builds then in effect says, "If the counter's value is V and action A occurs, then set the counter to M." Simple logic can detect the illegal states (entered perhaps via a noise pulse) and cause the counter to be set to some specific value. The counter's value is then indicative of the system's state. The counter is set to a particular value (system state) in response to detecting particular conditions in conjunction with a specific counter value. Fig. 12 shows in a general block diagram manner how logic for Fig. 9(a) would be implemented. Figs. 13(a) and 13(b) illustrate two approaches to implementing the set logic and state counter (actually a register). Fig. 13(b) is preferred since it isolates the setting logic from the state register itself. The practical implementation did not follow these guidelines but was a piecemeal project built up as a series of small logic modules. The actual logic details are not all that important, providing that the state diagram is faithfully implemented in the hardware.

A system diagram is shown in Fig. 14 to illustrate the component parts of the system – above and beyond the control logic.

While the heart of the system is the control logic, the most sensitive component is the VOX unit. The VOX unit employed was an adaptation of the solid state unit appearing in the 1972 edition of the ARRL Handbook. Minor modifications were made in the anti-VOX circuit to adapt its operation to this application.

The most difficult problem that had to be overcome was false tripping of the VOX circuit each time the transceiver (a Motorola W43GGV) switched from transmit to receive. The problem caused cycling – the unit would switch from transmit to receive to transmit to receive, etc. The problem was traced to the fact that dc microphone bias was being switched on and off. Removing

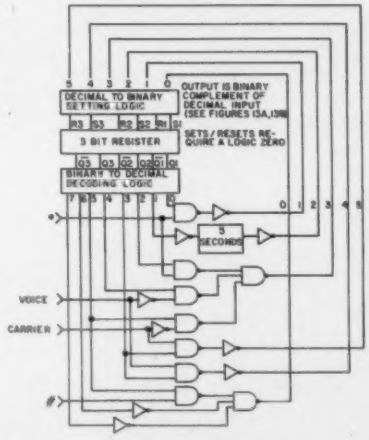
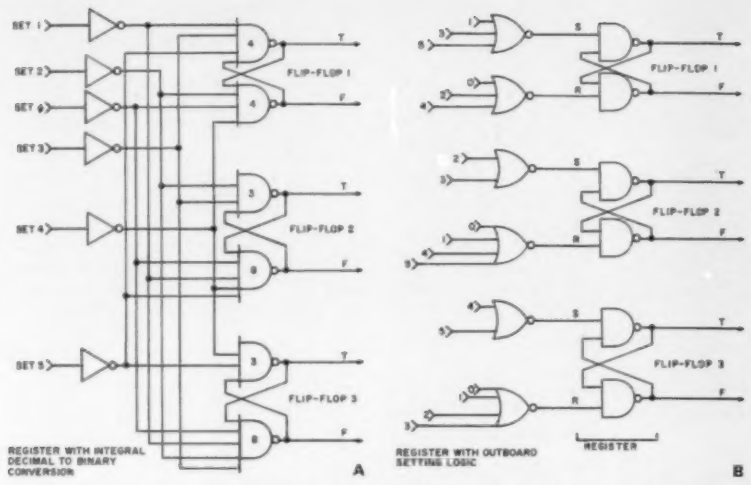


Fig. 12. Block diagram of recommended autovox system logic.



Figs. 13(a) and 13(b) illustrate two ways to implement the set logic and state counter.

the bias circuit, intended for carbon microphones, cured the problem.

The VOX circuit should have fast attack and slow release to be most effective. Employing some agc ahead of the VOX unit can be helpful in accommodating various speaking levels and telephone circuit conditions. The most serious operational characteristic occurs when the telephone party responds to questions too quickly, resulting in a missed or partial transmission – the result of the VOX attack time and transmitter keying time. The same problem occurs on conventional two frequency autopatch systems as well when the telephone party responds before the mobile user has had time to switch from transmit to receive.

The autovox patch is easy to use and can render service if a good VOX circuit is employed. The system's primary weaknesses include the variability inherent to VOX circuits and the fact that the mobile user doesn't have absolute control of the system (he must wait to grab control).

An Operational Time Division Autopatch on 27 MHz AM

To help in the investigation of a time division autopatch, the control logic shown in Fig. 11 was constructed using T^2L components derived from discarded computer circuit boards. Flip flop XA9 is the mode control flip flop and is representative of state 1. This flip flop is set either by a push-button switch, SW1, or upon receipt of the * character (tone detector outputs H_3 and L_1); it is reset by a push-button switch, SW2, upon expiration (momentary logic 0) of the 1 minute timer, or upon receipt of the # character (tone detector outputs H_1 and L_1).

The sampling process, i.e., looking for an incident signal, is accomplished by use of a 2-bit binary counter. The sampling process is actually sub-divided into four periods. Fig. 15 shows the actual sampling process. A unijunction timer is used to determine how frequently this process is performed – in the experimental system, several time periods were switch selectable between approximately two times per second and once every five seconds (the basic timer circuit is shown in Fig. 16). The rate at which the 2-bit counter was cycled was controlled by a separate UJT clock circuit controlled by a variable resistor to provide widely variable sample durations. Fig. 11 shows the frequency control timer as T_1 and the sample clock as T_2. The flip flop composed of gates XA13-3 and XA13-4 is representative of state 3. The flip flop composed of gates XA15-3 and XA15-4 is representative of state 2. Gates XA12-1 and XA12-2 decode the counter to determine when the receiver should be enabled. Gate XA12-2 decodes the second "receiver-on" period and thus generates the "SAMPLE" signal as well.

Gate XA11-1 produces an enable for the receiver under four conditions:

1. Sample period 1 or 2;
2. Carrier present on input;
3. Patch off;
4. Local mode and PTT button not pressed (gates XA10-2 and XA10-3).

Gate XA15-2 causes the flip flop composed of gates XA15-3 and XA15-4 to be set when a carrier is detected during the sample period. Gates XA11-2 and XA14-2 compose the transmitter keying logic – providing an enable under two conditions:

1. Local mode and PTT button pressed;
2. No sampling in progress and no incident carrier.

This logic was interfaced with modified Radio Shack Model TRC-4 100 mW CB transceivers that were interconnected with a simple phone patch. Reliable operation was obtained while wandering around the house carrying an unmodified TRC-4. For simplicity, one transceiver was used as the receiver and the other one, with PTT button wedged "on", was used as the transmitter. Lots of experimental work was done to get reasonable response times. The transmitter was not modified – simply keyed on and off with a transistor switch in the power lead. The receiver required modification in the agc circuit to speed it up. Because of capacitor charge conditions, the receiver came on most *insensitive* and gradually increased its sensitivity. A transistor switch was added to remove the capacitor until a signal was detected and then replace it to control the amplification process and reduce distortion. A carrier detector was added to produce a dc voltage when a signal was detected. This signal was in turn amplified by op amps, passed through a Schmitt trigger, then to a monostable, for delayed dropout. The output of the monostable was the signal named CARRIER appearing in Fig. 11. This simple account over-simplifies the matter somewhat because receiver sensitivity was still somewhat deficient. This may have resulted from transmitter turn-off problems. Having no equipment other than a VOM, it was difficult to really study what was happening. Adequate equipment and a better electronic engineer could have no doubt worked wonders! But, the circuit did work – so well, in fact that on several occasions, I talked with my father over long distance circuits and he was totally unaware of the radio system's operation.

The radio party hears a "tick" each time the base station ceases transmission to look for a carrier; the telephone party hears only the received audio since audio gating is enabled only when a signal is present.

Just for the sake of proving it could be done, the control unit was connected to a stock Motorola W43GGV tube-type transceiver. By making the sample period very long, even a unit with PTT *relays* worked acceptably. While this is certainly not recommended, it would be interesting to attach a fully solid state unit employing solid state antenna and power switching (such as the Varitronics IC-2F). A suitably designed transceiver could no doubt vastly improve overall system performance by rapidly getting the transmitter squelched and the

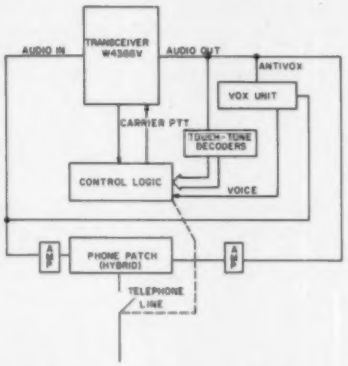
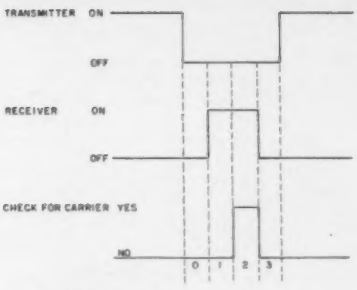


Fig. 14. Component parts of a practical autovox system.



SAMPLE PERIOD COUNTER VALUE	ACTION
0	Transmitter off
1	Receiver on
2	Check for carrier
3	Receiver off

Fig. 15. Detailed carrier sampling process.

receiver up to maximum sensitivity.

The time division autopatch has many significant positive characteristics:

1. It is fully automatic;
2. Control is in the hands of the radio party;
3. It uses a single frequency;
4. It uses a single antenna with no need for a diplexer;
5. It requires no special phone line quality or telephone party conduct.

It also exhibits one significant negative characteristic – the base station must be able to switch from transmit to receive very quickly.

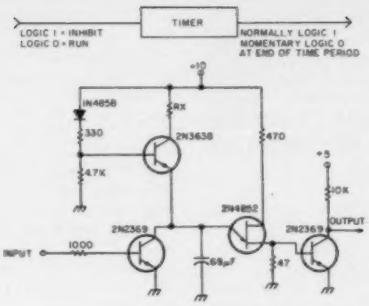


Fig. 16. Basic timer circuit.

Conclusions

All of this thinking and work with single frequency autopatches came about because one Florida amateur, after reviewing my repeater system equipped with an autopatch, said to me, "It's too bad you can't build a single frequency autopatch." To Hank Bach, I say "Thank You." The thinking and researching have been rewarding. Maybe one of these autopatches, perhaps the time division autopatch, will be just what is needed to provide reliable half-duplex telephone service on a single frequency to thousands of mobiles already equipped with various types of standard transceivers.

Legality Considerations

The FCC's revised repeater rules are known to us all. This experimental system was designed to be fully automatic and reliable so that the need for a base station operator could be totally eliminated, while at the same time it halved the amount of frequency spectrum used (compared to conventional autopatch systems). The FCC has taken a dim view of "telephone only" repeaters, yet many repeaters exist mainly to support everyday telephone communications. So far as I know, a system such as the automatic VOX patch might be legal for the land mobile service although not for the amateur service. My interest has been in advancing the technology – not quibbling over rules and regulations. My goal has been met – it would, however, be enjoyable and encouraging to learn that the operation of such a telephone system for strictly noncommercial purposes and emergency communications was in fact permissible. There are many times each week that I would like to make a personal phone call to check on the family "milk" needs, and at the same time prove that the system is ready to render valuable community service in the event of an emergency. We can only hope that the FCC will recognize the merits of systems such as this one. Can you imagine the potential impact of a national single frequency autopatch system? In the meantime, 10-4 y'all! ■

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EDITORIAL BY WAYNE GREEN

from page 24

Considering how things are going, it would seem prudent for all of us not yet active on CB to start looking around for a rig. We'll not only get the smokey clues which CBers are enjoying, but also get to meet some nice people who are solid gold prospects for ham licenses. You'll also find a lot more traffic information available to you while driving than you get through the local repeater . . . CBers outnumber the hams about 100 to 1 these days.

Remember back, you older timers, to when CB was first introduced. At that time a lot of us thought that this would be a great start for getting people interested in ham radio. The illegal type of operation, which the old rules promoted, made the 11m band a playground for the type of people we didn't need . . . and which would never be much interested in amateur radio where they would have to actually work to get a license. The present CB gang has engulfed the old high power bad language creeps and are, for the most part, quite decent people. Now, as the FCC manages to get licenses into CB hands, you even hear actual call letters beginning to replace handles!

We don't have to try to lick 'em . . . just join 'em and sneakily winnow out the best of the CBers and get them into our ham classes. It will be a painless . . . fun . . . missionary job.

Yes, I know . . . I can hear the old curmudgeons now . . . *73 Magazine* . . . the amateur radio and CB magazine. Go soak your heads . . . right after listening to CB 1976 and finding out what it is really like. My apologies if you find CB to be rotten . . . it isn't most places, but there are exceptions.

NEW 220 MHz CB BAND?

Despite the ads by NRI in *QST* and *HR* for their new 220 MHz CB synthesized rig, the FCC assures me that plans for this ham band to go CB are dead. Several readers wrote me about this obviously deceptive advertising, wondering how these magazines could run such an ad. Beats me!

While most of my past prejudices against CB have been overcome by recent developments, I'm not yet ready to cope with CBers on 220 MHz who are convinced that their NRI 500 channel digitally synthesized rig is perfectly legal.

We, as amateurs, do have to come to grips with CB as it is today. We need to understand what it is and how we can best relate with this. Letters are pouring in from all over the country telling me that ham clubs are having more and more success in converting the more intelligent and decent CBers into licensed hams. Bravo.

We also need to be wary. The renegade element which has moved above the 23 channels gets a wild hair every now and then and ventures above 28 MHz. This sort of trip should be stopped with every tool at your disposal. It will be a lot easier to stop now than when the sunspots start perking again and all sorts of rare DX become available.

One of the last things we need is an open invitation for CBers to jump unlicensed into a ham band. Hopefully *QST* and *HR* will correct the idea that there now is a 220 MHz CB band . . . and perhaps take a firmer stand with advertisers who try to run deceptive ads.

My thanks to the many readers who dropped notes to the offending magazines . . . WB2LEI, K7DBU, etc.

BOOK MAGIC

Have you ever started to get into some new phase of amateur radio, only to find that getting the information you want is a bear? You look through your back issues and find some info, but key articles are missing, and you end up spending enormous amounts of time trying to get what you need . . . and kicking yourself for not being more careful of those back issues.

One obvious solution to this misery is to go out and buy a book or two on said new interest so you'll have everything in one place. This is okay if you are into RTTY or SSTV, but a lot of other phases of amateur radio are not covered adequately by books . . . as yet. We're working on this problem at *73*, but we need help.

Publishing specialized books for amateur radio is not one of the all time lucrative efforts . . . which explains why there are not all that many books available. Yet, for the amateur who can write . . . and has a field of expertise . . . there is interesting spare time money to be made. If you are into any amateur specialty . . . say certificate hunting, for example . . . you could work this into one or two thousand extra dollars by contacting me and proposing a book on the subject.

The book series we are working on will all be around 100 pages of 8½" x 11" and sell for $1.95 through the stores. A good book will sell at least 10,000 copies, with some going up to over 50,000 . . . though that is unusual. While most publishers pay royalties on the order of 5%, we will be paying 15% . . . since we don't want to disturb our long-standing non-profit way of life . . . ARRL is not the only outfit that can lose money year after year and grow nicely in the process. That means there would be a royalty of about 19.5¢ on each copy (wholesale price would be $1.30) . . . or about $1950 on 10,000 copies. It isn't a lot these days, but a little bit here and a little there . . . right?

If you can't think of any books to write, it is because you have been riding on the coattails of others. Books would be welcome on things like 160 meters, 75 DXing, contests, traffic nets, low noise circuit design, circuits of commercial amateur rigs (royalties on non-expert material have to be negotiated), buyer's guide to ham gear available, buyer's guide to microcomputer equipment and peripherals, updated index to surplus conversion articles, microwave equipment, getting on 450 MHz, ATV, FAX, intro to microcomputers, intro to common programming languages, mobile handbook, introduction to amateur radio, license manual, how to become a radio amateur, understanding amateur radio, radio fundamentals, amateur operating manual, learning the code, VHF manual, CB equipment guide, getting the most out of CB, things like that.

If you like the idea of some extra money and think you can turn out a good and interesting book, make an outline and send it in for an okay. Proven authors will get preference, of course . . . but this is an opportunity to get your feet wet . . . if you can hack it.

CASH BONANZA

Every now and then I get a letter from some reader sniveling about not being able to afford this or that piece of ham gear. The sniveling is getting even worse with the cost of computer systems running around $2000. My answer is simple . . . you have plenty of good training to make a lot of money in your spare time, so why sit around writing complaining letters to me when you could be out there raking it in?

The CB explosion is a case in point. It is getting tougher and tougher to make a buck selling CB equipment . . . you're in competition with discount stores and truck stops . . . outfits with relatively low overhead and enormous buying power. But remember that these days the big money is in service, not in selling . . . and service is one thing that CBers need . . . desperately.

You could set yourself up installing and servicing CB rigs and do very well in many areas. It is a business you could get started in your evenings and weekends. You'll be able to work in a good deal of accessory sales as part of your business, too . . . for most CBers will be willing to pay quite a bit to get rid of all that car noise . . . and you should be able to sell car security systems like crazy.

How do you get customers? Over the CB channels . . . with business cards at all sales outlets (offer a little kickback to the salesman if you get the installation job . . . make that a "commission") . . . ads in the newspaper . . . etc.

Speaking of car noise, I'm still hoping that somewhere out there at least one *73* reader has discovered how to quiet the deafening noise in a Datsun! Please give me a hint. My 280Z has to be heard to be believed and the local dealer says nothing can be done.

EDITOR NEEDED

73 has an urgent need for a ham in the editorial department. A background in both the technical and operating ends of the hobby will be advantageous . . . as will the ability to read and write. Fun job . . . fantastic area for living . . . reasonable pay . . . lots of hamming . . . excellent opportunity.

BYTE TROPHY

The Southern California Computer Society awarded a beautiful trophy cup to *Byte Magazine*. Here is Wayne Green, the originator of the idea for the magazine and the publisher who got *Byte* started, admiring the trophy.

TECO has a large inventory of these units in stock.

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be my guest

visiting views from around the world

from page 9

of the mode or special interest directly involved. I suspect that it is reasonable to say that those involved in a given mode are the closest we will have to experts in that mode, and therefore they should be the people to work out solutions, unless a specific problem arises between adjacent users of two or more different modes. Even then, it should only be those involved who work toward a solution. However, all findings on any problem should be disseminated to all representatives of all groups, so that meaningful dialogue between various special interest groups can be developed.

Another important input at this level would be that of our international neighboring nations: Mexico to the south and Canada to the north. Let's face the fact that transmitted rf energy rarely if ever observes international, or even state, boundaries. Since rf originating in our country affects them, and vice versa, we must develop the same lines of interaction and intercommunication with them in order to protect their rights and, in the end, thereby protect our own. Then too, we may very well gain from their technology — and that never hurts anyone. Most of all, we gain a good deal of international fellowship and good will by extending the hand of friendship to our neighbors, and this fellowship can only benefit us at the '79 WARC in Geneva. The friends we make now will be of definite benefit then, and in times to come thereafter

By this time I hope you have noted that the arrows connecting the different tiers and organizations in the diagram are all two way. I feel that this is extremely important in that all communication and interaction must be two way; all must work for each other and information disseminated at any level must be made available to all interested. The same holds true for all areas of the country, in that east can learn from west, north from south, neighbor nation from neighbor nation, etc. We must pool what we have already learned and what we will learn in the future so as to avoid repeating costly mistakes — the kind that make enemies out of amateurs who in reality should all be friends working arm in arm toward one specific goal: the future survival and growth of the amateur radio community worldwide. On each level we must break down the walls that now divide us, such as things like "license class bigotry," wherein amateurs of one license class profess superiority over others simply because they have passed a harder test. Or the walls of isolationism between amateurs due to the specialization of the mode in which they operate. I have always believed that it's not the license class you hold or what you are a specialist in that counts, but rather what you as an individual do with these assets and how you use them to benefit the entire amateur community. Though some may not like the realization, the times have changed swiftly for us and are everchanging. Unless he or she wakes up soon, the isolationist and the bigot will very soon be left out in the cold with no home and, even worse, no one to QSO with. It is for this reason that every special interest group must be represented, from the local council and/or workshop level to the statewide level. Now, where to from here?

Logically, one would think that from here we should go national and, while I agree, there are too many pitfalls. While on a local level it is fairly easy to hold meetings, as you progress up the scale distances between given points becomes a significant factor in both time and cost. On a statewide level things would still be quite tolerable, in that such statewide meetings could be held in conjunction with a major amateur radio convention. While admittedly it's an assumption on my part, I really feel that the kind of person who is politically motivated enough to garner election from his particular local council is the same amateur who rarely if ever misses a major amateur get-together such as a Division Convention or other major area happening. Therefore, scheduling meetings of a statewide organization to coincide with a major event such as a Division Convention would probably attract the necessary attendance.

When you speak of a national get-together perhaps twice yearly or even quarterly, you speak of big travel and time expense. This was brought home graphically to me just yesterday, when I learned that a trip Sharon and I are planning to New York later this spring will cost almost $700 for two round trip (coach) airline tickets. No one amateur or group of amateurs could be expected to cough up perhaps two grand per head per year travel expenses. Even if a group did, could you see trying to accomplish anything of value with 100 delegates, plus who knows how many advisors to each (figuring two delegates per state plus one alternate), crammed into one room in Newington? Why Newington? Well, aside from the ARRL, I know of no other organization capable of undertaking as large a job as this.

Therefore, some semblance of order must be achieved before chaos is permitted to develop. Here enters the areawide or regionwide council. Let's say that four such councils were established along time zone or other boundary lines, and that quarterly or semi-annual meetings for these councils were established. Now you have quartered the numbers of people attending and minimized as much as possible the travel necessary — and thereby the associated costs. To areas such as Hawaii, Alaska and Puerto Rico, this would be a definite expense benefit.

This level would have two prime purposes aside from the aforementioned. First, it would act to develop lines of communication between its three peer organizations — to collect and disseminate information, and to solve problems between statewide organizations. It would not involve itself in local procedures and policies, as these would be left to the local and state bodies. In fact, its main purpose other than those already stated would be to act as a clearinghouse for information that would be presented from a given area to the heart of the entire body: the National VHF/UHF Spectrum Advisory Committee.

Let us now elect two delegates and one alternate from each Regional Area Council (and fund them with money prorated from dues collected at the lower levels), place them aboard their favorite mode of transportation, and send them off twice a year to the city of Newington, Connecticut. Their job would be the hardest: to analyze all aspects of VHF/UHF amateur operation on an ongoing basis and recommend changes that would benefit all spectrum users. To do this, they would need all forms of inputs and, as the chart notes, as many as possible are provided. First, the people whom they directly and indirectly represent will have given them basic direction as to what is needed. Second, the needs of neighboring nations must also be

Continued on page 136

More from the Son of a Gun

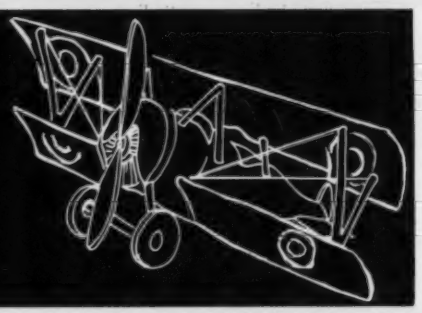
One of our more strung-out QRPers came up the hill last week, his voice ringing across the ridges, joy in his smile and happiness everywhere. A couple of us were just sitting around and we braced for the worst. "I did it," the QRPer was yelling, "I did it, I did it! This time I got one for sure and it has to be a real blockbuster for sure." We calmed him down to get the story out of him. "This morning, on the dawn path, I worked this AC8BT/AJ4. There was this big pileup of JAs fighting to work the station and I knew that it must be a real rare one. So I jumped in and worked him . . . got a five-eight-nine out of him, too. I don't know where it might be but with Sikkim gone I'm wondering if it might be one of those other Himalayan kingdoms, something around Tibet. It might even be China. What do you think?" Son of a gun, what could one say to something like this on a warm day, the sky blue and the flowering trees all in early bloom? We finally said, "We'll have to research this one and try to get a line on things," and the QRPer was off, jogging his way down the hill. The two of us sat in silence for a bit and finally the other spoke. "Why didn't you tell him that AC8BT/AJ4 is Al Hix from Charleston down in Puerto Rico to warm up a bit?" We were long in answering for there are enough of the dark days and this for now was a happy one for the QRPer. And at the end all we could say was, "Take from no man his dream." And there are yet those happy days in DXing and there will be more to come.

* * * * *

One of our more recent QRPers came by last week and he had a question. "Why are the older DXers always sitting around and talking about the good old days?" he asked. "Were things really all that good and were they really the Big Guns that they say they were?" We have often been troubled by this question ourselves, so we hauled the QRPer over to the Old Timer who listened to the question. "A man must preserve his self-esteem," the Old Timer said, "and some may tend to rewrite the remembrance of other days and other years. The years that are gone will always be the golden years. It comes to most everyone." Son of a Gun, you would have thought that the QRPer had all the answers he needed, but he persisted. "But did all those things really happen? Are all the things they say true?" And the QRPer waited for his answer until the Old Timer spoke again. "It may not be, but they believe. And what does it really matter?" And we had to leave it there, for nostalgia is the warmth of the old ones and the years will bring to everyone, eventually, the recollection of the good days that were, and a thought of some things that might have been, but never were. Always somewhere there will be someone whistling "Roses are Blooming in Picardy." And always next year will be the Big DX Year. ■

Reprinted from the West Coast DX Bulletin.

Autobiography of an Ancient Aviator



W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230

For a couple of months now I've been promising to tell you about an outstanding hunting trip that it was my privilege to be on. So here's the story.

In early November, 1928, Belin DuPont of Wilmington, Delaware, invited Bob Hewitt, (manager of the Ludington Philadelphia Flying Service), Victor Dallin (aerial photographer), Jack Thropp (manager of Trenton Airport), John Steffin (Philadelphia businessman) and myself for a week of hunting at the DuPont Combahee Plantation in South Carolina. As I remember it, the plantation consisted of about 10,000 acres situated near the mouth of the Combahee river, about halfway between Charleston (of horse diaper fame) and Savannah. Bob Hewitt made arrangements with Townsend Ludington for the use of his flying service's new six passenger Travelair for the trip. We were scheduled to depart on Saturday, November 24th, but, due to my late arrival that day from my trip to Wichita, our departure was postponed to Monday. So Monday morning we loaded our gear and cut cards to see who would drive to Raleigh on the first leg of our 600 mile trip. I cut the high card so we got under way. The weather was cold with rain and sleet, but the weather report was for warmer temperatures to the south. However, a few minutes after takeoff we began to take on quite a little ice. By that time we were nearer Bellanca Field (near New Castle, Delaware) than Philadelphia, so I set the ship down there. We had so much ice onboard that I had to land at about half throttle. The Bellanca boys put our ship in their heated hangar, so in about an hour the ice melted off. Also, weather had improved considerably, so we were on our way again. The rest of the trip was routine. The plantation had its own landing strip, which was well marked. We made it just before dark.

Combahee Plantation was beautifully organized for hunting parties. There was a choice of deer, duck, quail or pheasant hunting. In the evening, after dinner, the guests would meet with the plantation manager and each plan his next day's hunting. Breakfast was at 0500, so the duck hunters could be in their blinds with their live decoys in place well before daylight and the deer and bird hunters could be in position. There were plenty of guides. One went out with each duck hunter, taking him to his alloted blind by boat, anchoring his live decoys in the proper places, retrieving the birds he shot, and bringing the hunter, bag and decoys back to the big house when the morning flight was finished. The deer hunters were posted along a trail, and beaters with whistles, horns and bells would form a chain and drive the deer toward the hunters. The field hunters each had a guide and a retriever. Gold plated hunting — What? The meals, of course, were marvelous. We were there for five days and arrived back at the Philadelphia airport on 1 December with some 18 quail and pheasants, 35 ducks, one small deer, and an unrepayable debt to Belin DuPont.

When I got to my week's accumulation of mail the next Monday, I found one letter from Washington giving me a $400 a year raise, and another one advising me that I was transferred to Kansas City as of 1 January 1929, to be in charge of the Central Region. I didn't like the idea of moving so far away from our farm in Bethlehem, New Hampshire and from all my friends in the East.

When the Ludingtons learned of my pending transfer, they offered me the job of building and managing an airport on land they owned near Camden, New Jersey. The salary they offered me was about double my Dept. of Commerce pay. In addition they offered to rent me a house they owned in Pennsauken, N.J. (near the airport site) for about half the going rate. So who could refuse? The frosting on the cake was that they would like to have me pinch hit as a pilot for the Ludington Philadelphia Flying Service when needed. I took my resignation to Washington as soon as I could get it off the typewriter.

Washington offered to let me stay at Philadelphia at the new salary, but I had to refuse. After all, the reason I joined them in the first place was to find a worthwhile job in commercial aviation.

First thing Ludington wanted me to do was to make an inspection tour of the more active airports in the U.S. and see how they were doing things, their problems, and get any ideas that would be of value in building Central Airport at Camden.

I was already familiar with the airports in my old territory and around New York, so I started my itinerary with a visit to Lt. Duffy at Buffalo Airport. Then, next day, on to Major Berry and his Cleveland Airport. Then I traveled by train at night and made one day stops at Detroit (Ford Airport), Chicago's Midway, and St. Paul Airport. While in Detroit I contacted a friend who was a "revenue agent." He very kindly drove me around and, before I left, gave me six bottles of very fine confiscated (he called it "liberated") Scotch. Those were prohibition years. Remember? I spent the weekend on the choo choo from St. Paul to Salt Lake City. Time to relax and get caught up on my reports. Not much to see at Salt Lake, so I caught the midday train for Oakland, California. Ed Mouton met me at the Oakland Airport and ferried me over to the San Francisco Airport at San Bruno in his "Deep de Corn" plane. Roy Francis showed me around his 'port, bought me dinner, and put me on the train for Los Angeles. I spent the weekend looking in on C. C. Mosley at Grand Central, Maj. Barnitz at Inglewood and the L.A. Metropolitan Airport at Van Nuys. I only had two bottles of Scotch left by then, so I climbed on the rattler for Kansas City. A couple of days enroute and another two in K.C. and I was ready to go on to St. Louis.

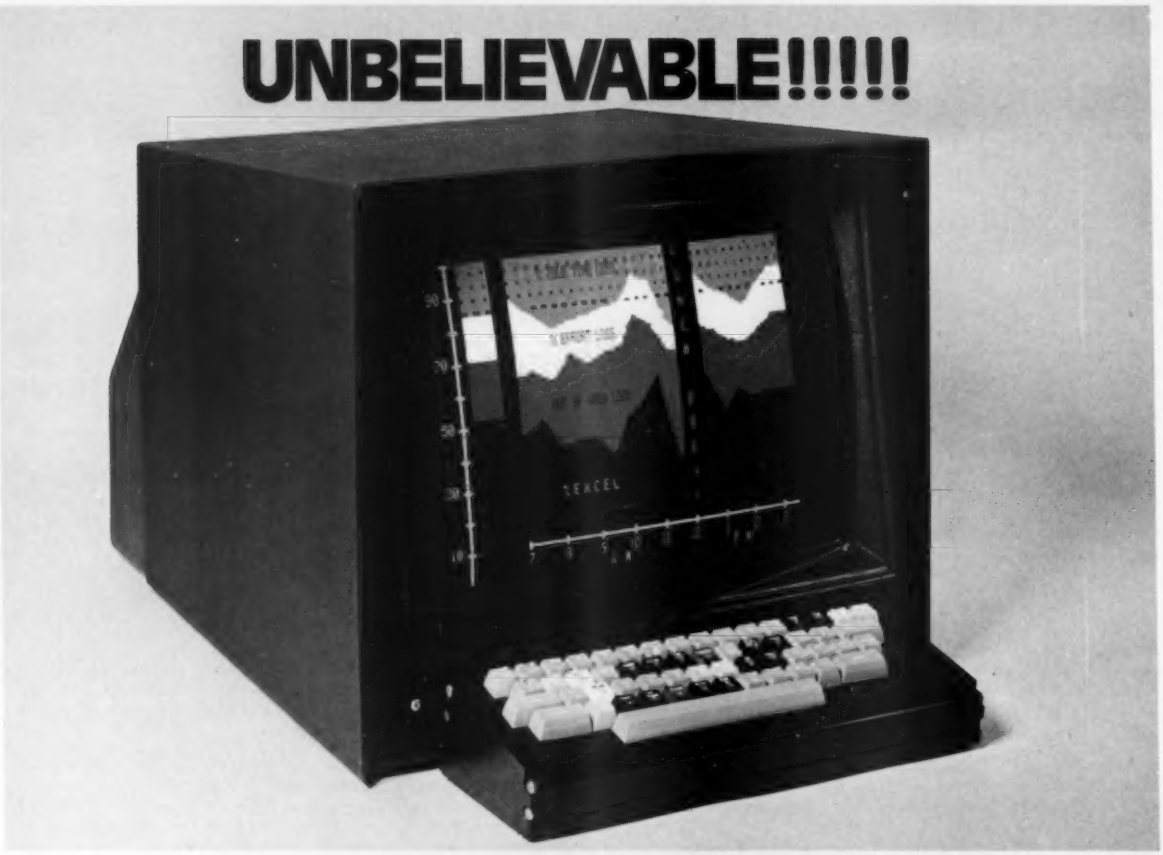
While I was in K.C. I heard that air transportation to St. Louis was available the next morning. I can't remember the name of the carrier but I remember buying a ticket and being the only passenger in a 4 passenger Ryan. The ship had dual controls so I sat up front with the driver. He told me he had just started work for the line and that this was his first trip over that route. I told him that I had been over the route a couple of times the month before under similar conditions and I thought that, between us, we should have no trouble. I suggested that he take a 100° course until we came to the Missouri river then, if it was still snowing and the visibility wasn't too good we could follow the river right down to Lambert Field. That's what we did — and arrived a few minutes ahead of schedule.

I had a nice weekend in St. Louis. Those people certainly know how to entertain visiting firemen. In Cincinnati I caught up with a couple of old friends at Lunken Field: Ed Conerton and John Paul Riddle. Paul was running the airport and the Embry-Riddle Airline. Ed had landed the "Voice From The Sky" Fokker trimotor there the day before and the heavy sound equipment it carried was enough to break its back in landing. So I spent an extra day with them before climbing on the night sleeper for Philadelphia.

Next month: Building Central Airport and small airline flying.

Hunters' arrival back at Philadelphia Airport, 1 December 1928. Left to right: Vic Dallin, John Steffin, Bob Hewitt, Jack Thropp, Sanger Green. Photo by Dallin Aerial Surveys.

UNBELIEVABLE!!!!!



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I/O EDITORIAL

by Wayne Green W2NSD/1

BILLIONS . . . BILLIONS!

It isn't often that we can see quite so clearly a new market that is inevitably going to burgeon. Usually, when you can see something like this coming, you can use the information to make some money . . . like investing in Haloid just before it became Xerox. The coming explosion in computers . . . which will dwarf the already well-known computer growth . . . does not give us any clear insights into turning a fast buck, but it certainly can be used to advantage.

I've already suggested that amateurs, by virtue of their head start in electronics, will have a decided advantage if they want to get into the sales or service of small computer systems. This is still a bit in the future, despite the opening within the last few months of a couple dozen computer stores around the country. Right now most computer stores are serving hobbyists rather than small businesses. This is primarily because to date there are really no practical small business systems available, only hobby systems. But business systems will be along . . . and shortly.

How much of a business will there be? I would think we could expect at least a $50 billion a year volume . . . and that probably is conservative. When computers get down to the $250 to $500 range, and they will soon, you will be seeing them everywhere . . . on every desk at school . . . every desk in every office . . . in every small business or store . . . in every home. They will be used for writing letters (most of which will eventually go via cable or satellite), keeping records, ordering from the store, billing, keeping bank records, teaching, games, art, music composition, newspaper replacement, etc.

If you are not really interested in getting into manufacturing or sales, you may want to look for investment in firms which are getting into these fields. While it is still too soon to get even a faint idea of how the pioneers in the field are going to do, you could do worse than keep a good eye peeled for up and coming firms.

uP AND AMATEUR RADIO

For some reason I've had a lot less static about the coverage of computers in *73* than I expected . . . less than when I got started on FM and repeaters some years ago. While I recognize that a great many readers understand the impact that computers are going to have on amateur radio, still I also realize that despite our efforts to keep the readership of *73* confined to active and progressive amateurs, some spark-forever types are bound to have infiltrated.

Just as many amateurs reacted violently to transistors, refusing for years to accept that they were here to stay (see the *OST* George Grammar editorials in the mid-60s). I expect this same reaction to the revolution microprocessors are bringing us. The idea of a small PC board with a few chips being able to replace very complex electronic systems is going to take some getting used to.

How can an old timer (of any age) get used to a tiny computer system which can be used to change typing into Morse code, into RTTY, for editing text to be typeset, for playing games, for teaching almost anything, for keeping a mailing list, for running a repeater, or for just about anything the mind can imagine? It is almost too big a step to really comprehend. Just by changing the programs in their computers, two amateurs can use their systems to communicate by Morse, RTTY with Baudot code, RTTY with ASCII code, or any other agreeable system. With a slightly different program the system will see what code is being received and cope with it automatically. Pity the old timer.

Since I'm as new at all this as you are, I'll be trying to bring you articles which will help us to learn . . . and as I begin to understand more of what is going on I'll try to keep you in touch. These new, relatively inexpensive, computer systems are a quantum jump for us, so we've got our work . . . and fun . . . cut out for us.

CONVENTIONS

The computer hobby field is getting big enough so they are already starting to hold conventions. An unusually high percentage of the computer hobbyists seem to also be radio amateurs, so you might find an event like this fun.

The first such convention, run by MITS at their plant in Albuquerque, is scheduled for the end of March . . . as this issue goes to press. I'm planning to be there and report on this convention. The next one is May 2nd in Trenton, New Jersey and is being organized by Al Katz K2UYH, a well known UHF pioneer and Oscar addict. I'll try to be there and report on that meeting, too. More than a thousand hobbyists are expected to attend. There will be manufacturers' exhibits, prizes, demonstrations of hobby systems, plenty of technical talks and a flea market. Write Trenton Computer Festival, Trenton State College, Trenton NJ 08625 for details.

THOSE BUGBOOKS

It would take two or three years to publish as much really good info on TTL circuits as is covered in the *Bugbook* series. The real pity of it is that all of the information in these fat books is utterly fascinating and *should* be published in *73*. This is just exactly the kind of material that every ham either wants to have or else should want to have.

Bugbook I starts right out with the basics of TTL circuits and chips, explaining how they work and how more complicated circuits are put together with the IC building blocks. The books are split about half and half . . . theory and practical experiments which you can hook together and see work. The experiments use inexpensive test jigs and commonly available (and inexpensive) ICs.

Look, I can't tell you what to do . . . if I could I would flatly insist that you get this series of books immediately and stop horsing around trying to avoid keeping up with progress . . . and trying to save a buck by making do with a couple chintzy magazine subscriptions. Oh, I do the best I can to bring you stuff like this in *73*, but there is just too much and you need it now, not in the two or three years it would take for me to get the material separated into articles and published . . . by which time it would probably be out of date.

Let me put it this way . . . the whole series of four *Bugbooks (I-II-IIa-III)*, which costs $36.85, will take you from beginner through microcomputers, complete with the fundamentals of programming . . . something you are going to have to learn eventually. This is a fun way to get into this, since it takes you step by step all the way through with experiments you can make.

If you want to be a cheapskate about this you can start out with the first two books for $16.95 and cover the TTL part of the digital experience. But be warned that I have no intention of letting up on you until you have the whole set and are able to read relatively sophisticated articles on microprocessors in *73* . . . and know what you are reading.

The drops in hardware costs will come from a combination of the benefits of mass production . . . note that you can buy a brand new black and white television set for under $100 as compared to a far simpler slow scan television monitor at $250 . . . and further IC developments. One IC video generator will undoubtedly replace the 50 IC generators of today . . . and soon.

Teleprinters probably won't be coming down as rapidly as TVTs, due to the mechanical complexity. They will be about as expensive as typewriters in all probability. However, it is quite possible that they will become obsolete if a simple system of developing hard copy directly from the TVT tube is worked out. Some TVT units already have a Xerox type of copy system, though they are not cheap.

When some sort of direct computer-to-computer communications system does develop . . . possibly based upon the ultra-cheap late night telephone rates which would permit a computer to call any other and leave a "letter" which could be read at the recipient's convenience . . . this might be the salvation of the forgotten consumer as far as mail delivery is concerned. It would at least get us away from those big thick envelopes full of brightly colored gasoline company offers of overpriced junk . . . or would it? We may well have full color TVT systems and still find those darned junk mail offers filling our morning TVT screens. The more things change, the more they stay the same, to coin a phrase.

And will the chap with the "Plaid Box" of the future be able to dump mail into a hundred thousand homes in one night via Ma Bell's lines? . . . and for free?

POSTAL DISASTER

With first class mail looking to go to 17¢ by next year and to around 25¢ in a couple of years beyond that, some viable alternative is a must. The post office is already spending money (though not in *73*) to try and get people to send letters as a result of the drastic drop in mail use brought on by the 13¢ letter. There is also talk of a three day postal week.

Continued on page 119

SEE PAGE 128 FOR 73'S COMPUTER INFO

MORROW'S Micro-STUFF

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"Recently, I've been designing memory and computer products for Bill Godbout Electronics... mostly high volume stuff. But while I experiment away in my "magic cellar", I come up with all kinds of things you might want. So much, in fact, I've decided to set up shop to handle the overflow. Also in my work, I come across new and interesting parts which I'll also offer to you. So, have a good time reading this flyer (make sure you don't miss the part about the FREE public service), and let me hear from you."

---George Morrow

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HELP WANTED

Many times computer hobbyist companies have no way of knowing what the response will be to a new product introduction. So, the standard procedure --- whether admitted or not---has been to announce a product, collect orders on it, and if the response is good, the company gets the product together...hopefully before people begin complaining.

We don't think this is a good way to approach things, so we're going to try a new method. Listed below are 4 products we're considering for introduction this year with each one identified by a number. On the order form on the other side is a "ballot". Rate the 4 products in order of your interest, with 1 being the one that interests you the most, 2 the one you like second best, and so on. Feel free to add comments, we'd like to know what you're looking for.

#1. 8K ROM board for JOLT systems; target price, $60. Sort of a "Naked ROM" board, using 5204s.

#2. Motherboard/Power supply for Altair/IMSAI machines, target price $130. Some neat features: 12A transformer/diodes/filter caps bolt on circuit board---no wires; solder mask prevents edge connector solder bridges; massive ground plane and other extras.

#3. 16K Static RAM board, ALTAIR / IMSAI compatible. Target price about $300, but memory prices are so volatile that figure is very tentatively given.

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---Examine and fill memory
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---Branch to, and recover from, programs

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This is a convenient little IC for computer hobbyists. Our package consists of the programmed 5204 as well as a complete software listing.

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THE CASSETTE INTERFACE, NAKED RAM, AND 8080 MICROPROCESSOR BOARD ARE ALL PARTS KITS USING TOP QUALITY PARTS, SOCKETS, AND BOARDS. EASY ASSEMBLY IF YOU KNOW HOW TO SOLDER AND CAN FOLLOW DIRECTIONS...OR IF YOU DON'T HAVE TIME TO DO IT YOURSELF, WE SELL ASSEMBLED VERSIONS FOR 35% OVER THE KIT PRICE.

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PLEASE NOTE: CASSETTE INTERFACE AVAILABLE APRIL 1st.

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Finally, the NAKED RAM connects into your system using the popular 3M style flat cable 40 pin connector, which is not supplied with the kit. However, we do stock AP connectors. For $20 we send you (2) male headers which solder into the board and (1) molded cable assembly, consisting of 2 female connectors connected together by a 3" piece of flat cable. These AP connectors have one especially neat feature: there are small holes on the outside of the connector so that you can probe the signal lines, which sure makes life easier if you need some test points.

8080 Microprocessor Board(s) $139.95

AVAILABLE APRIL 15th. Actually, we're talking about two boards here: the "Bigger Board" and the "Smaller Board". They have more similarities than differences, so we'll cover the common areas first:

Both are 8080 based systems with a crystal driven 8224 clock driver, using 8T97s as address buss drivers and data out buss drivers, and an 8212 as a receiver for the input buss. There are also a number of innovations...such as

**Onboard 8 X 32 ROM plus associated circuitry allows the microprocessor to be halted properly, so that the state of the machine (that is, registers, flags, stack pointer, program counter) are preserved at the keypad control panel. Once halted, the microprocessor executes a program in the on board EROM and allows the user to examine and alter all registers of the microprocessor --- just as if you were at the front panel of a minicomputer. This program also accurately simulates a step function, allowing the user to run through programs one step at a time. Either in step or continue, the original or user altered contents of all the registers and flags are restored to their original state before control returns to the user's program.
**16 key calculator type keypad and nine 7 segment readouts allow you to painlessly load and examine memory. Unlike some machines that only let you examine next, with this board you can also examine last, allowing you to retrace your steps --- catch errors, makes life easier when debugging. Tape recorders have always had rewind as well as fast forward; now your 8080 does too.
**In the on board EROM, there's software for an RS-232/TTY interface, and there's room on the board for implementing the hardware for this interface.
**The buss is four 50 connector 3M style flat cable connectors, arranged in such a way that with the aid of a paddle connector, this CPU can plug directly into the edge connector of an Altair type buss.

DIFFERENCES BETWEEN THE TWO

"Smaller Board"---card size 6.25"x15", which just by coincidence replaces both the CPU board and front panel of an Altair 8800, fitting in exactly the same area. When used in this manner, you have a cure to many of the problems experienced with other microcomputers: no overloaded address busses (LEDs being incorrectly driven), no one-shot driven clock pulses, no erratic front panel instruction execution, and none of that ready line problem either. Although this board isn't expandable on board like the "Bigger Board", you can expand by using standard Altair sized boards from companies like MITS, Godbout, Processor Technology, Cromenco, or other "second source" RAM and ROM boards.

"Bigger Board"---won't fit into the Altair front panel anymore, it's too big...but still plugs into the Altair buss. The extra board space buys you room for 1K of RAM, 4K of ROM, and two cassette interfaces for mass storage. If you're looking for a board that can be expanded at a later date, then this one is the correct choice for you. We also have options:

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1 - 18 Mhz crystal
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4 - 8T97 hex tri-state buss drivers

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"HELP WANTED" BALLOT: Please rate the four products in order of preference, as explained on the other side under "Help Wanted". THANK YOU VERY MUCH for your opinion.

	PRODUCT	RATING
#1	8K ROM Board for JOLT	
#2	Motherboard/Power supply for Altair, IMSAI	
#3	16K static RAM board for Altair	
#4	Floppy disc interface	

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Two Finger Arithmetic

-- how computers figure

We are not aware of all the number systems we use daily, as represented by the items shown here.

The first caveman, when he learned how to count on his fingers, gave us the decimal number system which we use today. While this number system is second nature to us, it is not the only number system with which we come into contact every day. Timekeeping, for example, uses a unique numbering system which is based on the numbers 60 and 24. There are 60 seconds in a minute, 60 minutes in an hour, and 24 hours in a day. And of course, the English have blessed us with unique number systems for weights and measures — who can forget that 4 gills = 1 pint, 2 pints = 1 quart, and 4 quarts = 1 gallon? If you stop to think about it, you can see that we are involved with many number systems other than the decimal system.

The advent of the computer age has ushered in an additional number system, the binary system based on the number two. This system has come into common use since digital computers can represent information in one of two states — "on" and "off." These two states are called "binary" states and are the basis for the binary system which we use in digital computers.

Man commonly works with the decimal system, computers operate with the binary system, and the obvious questions are "How do we get from one system to the other?" And, "How do I represent information in a computer?" This article answers these questions and in addition explains how to do simple arithmetic in the binary system.

The Decimal System

We are constantly thinking numbers, adding numbers, and writing down numbers; but, do we really have an understanding of what we are doing? When we write down a number such as the number 3187, what does it really mean?

All numbers are made up of a series of digits. A number can have as few as 1 digit and is not limited to any maximum number of digits. In the decimal system, each place occupied by a digit has a power of ten associated with that place. For example, in the number 3187, we have four places. The powers of 10 associated with the four places are as follows:

digit	3	1	8	7
power of 10	10^3	10^2	10^1	10^0

The number 3187 could be written as the following sum:

$$3187 = 3\times10^3 + 1\times10^2 + 8\times10^1 + 7\times10^0$$

and if we remember our basic mathematics we will recall that

$$10^3 = 10\times10\times10 = 1000$$

$$10^2 = 10\times10 = 100$$

$$10^1 = 10$$

$$10^0 = 1$$

(By definition, *any* number to the zero power = 1.)

When we write the number 3187 we are saying that we have 3 thousands plus 1 hundred plus 8 tens plus seven units (or ones). Similarly, larger numbers such as 5197283 may be represented as

$$5\times10^6 + 1\times10^5 + 9\times10^4 + 7\times10^3 + 2\times10^2 + 8\times10^1 + 3\times10^0$$

The Binary System

Computers operate with the binary system because each digit can have only one of two states — "on" and "off." Numbers are represented in a computer by a string of binary digits called "bits." Consider a number represented by 4 binary digits (bits) when off = 0 and on = 1. Four lights may be used to display the "on" and "off," or one and zero respectively:

number	(on)	off	(on)	(on)
numerically	1×2^3	+ 0×2^2	+ 1×2^1	+ 1×2^0

We know that

$$2^3 = 8 \qquad 2^1 = 2$$

$$2^2 = 4 \qquad 2^0 = 1$$

Our number represented by the lights above would be

$$1\times8 + 0\times4 + 1\times2 + 1 = 11_{10}$$

Instead of actually writing down lights to indicate the "on" and "off" states, we use the binary numerals 0 and 1. Thus in base 2 our number is written as 1011_2. If it is very clear that you are working with binary numbers, you may omit the subscript 2.

Conversion from Decimal to Any Base

Conversions from a given base to the decimal system can be made by expanding a number to the powers of its base (as shown in the previous section). But, how do we take a decimal number and convert that number to another base? The technique used for this type of conversion is the technique of successive remainders. As an example, convert the decimal value 43 to base two:

```
        21
   2 | 43
       42
remainder 1   is the multiplier for 2^0

        10
   2 | 21
       20
remainder 1   is the multiplier for 2^1

         5
   2 | 10
       10
remainder 0   is the multiplier for 2^2

         2
   2 | 5
       4
remainder 1   is the multiplier for 2^3

         1
   2 | 2
       2
remainder 0   is the multiplier for 2^4

   2 | 1      (doesn't go)
remainder 1   is the multiplier for 2^5
```

Our number expressed as powers of two is $1\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$ or 101011_2. Checking ourselves and converting back to decimal, $1\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 32 + 0 + 8 + 0 + 2 + 1 = 43$.

Binary Arithmetic

Arithmetic in the base two is very simple. You don't have to remember a lot of arithmetic facts; all you have to remember is zero + zero = zero, one + zero = one, and one + one = ten. As an example:

1	0	0	1
+ 0	+ 1	+ 0	+ 1
1	1	0	10

With binary arithmetic, whenever two or more ones appear in a column to be added there will be at least one carry bit added to the next left digit. For example, in adding

```
   11          right digit    1
  + 1                       + 1
                             10
                carry bit ___^
```

we get

```
carry→ 1

   11          and then      11
  + 1                       + 1
    0                      100
```

Storing Numbers in a Computer

When we talk about numbers stored in a computer, we don't normally speak of them in terms of bits (binary digits); we usually speak of them in terms of bytes or

words. A byte by definition is a collection of sequential bits. A byte can be any number of bits but is most commonly 8 sequential bits. A computer word is a collection of bytes and is defined as the number of bytes pointed to by one addressing operation in a computer. Words and bytes tell us about the organization of the computer. As an example, assume the standard definition of byte, where byte = 8 bits:

> The XDS Sigma 6 computer is a "32 bit" computer; it has 32 bits per word. 32/8 = 4, thus there are 4 bytes per word.
>
> The DEC PDP 11 series of computers have "16 bits" per word. It has two bytes per word.
>
> The INTEL 8080 microprocessor is an 8 bit microprocessor; it has 8 bits per word. Thus it has one byte per word.

The term byte is used very frequently as the definition for a unit of information. Alphanumeric characters (letters, punctuation, printable characters, etc.) are usually stored in coded form in "one byte."

Numbers written on paper are stored in visual form and for all practical purposes there is no limit to the size of the number on paper. In a computer, there are limits set, due to the "word size" and due to the arithmetic capabilities of the computer. In large scale computers, it is possible to work with very large numbers such as those which can be represented in 64 bits or more. In microprocessors, however, the limit is very small, usually being 8 bits but in some cases being 4 bits. The arithmetic capability that we are talking about is the type of arithmetic which can be performed in one computer instruction. It is possible to string instructions together and thus handle larger numbers. This is usually done by "software."

Computer Arithmetic

As previously mentioned, computers have limits set on their arithmetic capabilities. They cannot in a single instruction perform simple arithmetic on all size numbers; they are limited to performing arithmetic on some given number of bits. Because of these limitations, computer arithmetic is somewhat different from binary arithmetic. Computer arithmetic is binary arithmetic within limits.

A typical microprocessor, such as the Intel 8080, has 8 bit arithmetic capability. It can perform arithmetic on 8 bit numbers. It cannot in a single instruction operate on a 32 bit number.

The largest number that can be expressed in "8 bit arithmetic" can be determined as follows: Consider an eight bit binary number such as 11111111_2, all one bits in the eight bits. The number can be expanded as $1x2^7 + 1x2^6 + 1x2^5 + 1x2^4 + 1x2^3 + 1x2^2 + 1x2^1 + 1x2^0$, which is the same as $128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255_{10}$. This is the largest number that can be stored in a single 8 bit word (or byte) and also the largest *sum* that can be accumulated from the addition of two numbers. We can add $250_{10} + 5_{10}$ and get a sum of 255, but we cannot add 250_{10} and 6_{10} to give 256_{10}, since that sum is beyond the arithmetic capabilities of 8 bit arithmetic. Of course this arithmetic restriction only applies to a computer with 8 bit arithmetic. If the computer used 4 bit arithmetic or 32 bit arithmetic, then the actual largest number would be different. In a four bit arithmetic microprocessor, the largest number would be $1111_2 = 1x2^3 + 1x2^2 + 1x2^1 + 1x2^0 = 15$.

In order to simplify the examples, all discussion in this section will pertain to a microprocessor or computer with 8 bit arithmetic capability.

If our microprocessor can handle eight bit arithmetic and can also store sums up to 255, then what is to prevent us from attempting to add two numbers that will produce a sum greater than 255? The computer doesn't know what the sum will be before the addition, so we can at least make an attempt. The answer is, "Yes, you can instruct the computer to perform the addition, but the results will be wrong." An *overflow* condition will result. The storage capabilities and the arithmetic capabilities of 8 bit arithmetic will be exceeded. What happens is analagous to trying to pour 3 quarts of water and 4 quarts of water into a five quart container. The container will overflow.

Subtraction and Negative Numbers

Most microprocessors available today have subtraction capabilities; however, the microprocessor user may or may not wish to use those subtraction capabilities, depending on the capabilities available. The user may wish to "complement" the number to be subtracted and then perform an addition, so that the arithmetic techniques may be simplified. Two types of computer arithmetic will be discussed in this article – ones complement arithmetic and twos complement arithmetic.

Both negative numbers and subtraction are used in a computer, but not necessarily in the same manner as with pencil and paper. In order to indicate a negative, instead of writing down a minus sign on paper a "sign bit" is set to "one" somewhere in the computer. This "sign bit" may be stored in a word by itself or it may be stored in the same word in which the number is stored. Most commonly, the "sign bit," which indicates a negative number, is stored with the number itself in the leftmost bit position of the word. In an eight bit word, the sign bit would be as shown:

Sign bit ⓧ x x x x x x x

In a sixteen bit word the sign bit would still be the leftmost bit as:

Sign bit

ⓧ x x x x x x x x x x x x x x x

If the sign bit is a "0", then the number stored in the word is positive. If the sign bit is a "1", then the number stored in the word is negative.

The maximum range of numbers which can be represented in an eight bit computer would be as follows:

Sign bit

01111111 = 127_{10}
(Most positive value)
01111110 = 126_{10}
.
.
.
00000010 = 2
00000001 = 1

00000000 = ZERO

11111111 = -1
11111110 = -2
.
.
.
10000001 = -127_{10}
10000000 = -128_{10}
(Most negative value)

In an 8 bit word we have defined one bit as the sign bit, leaving 7 bits for the data. This means that the largest number including sign that can be stored in an 8 bit word is 127_{10}. This puts a further restriction on arithmetic operations as can be seen by the example, 64 + 64.

	64 in binary	= 01000000
+	64	= 01000000
		10000000

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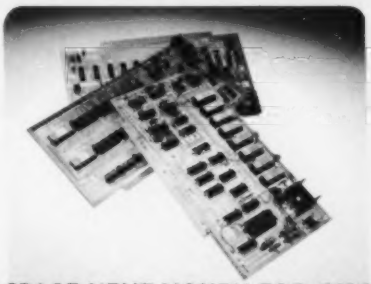

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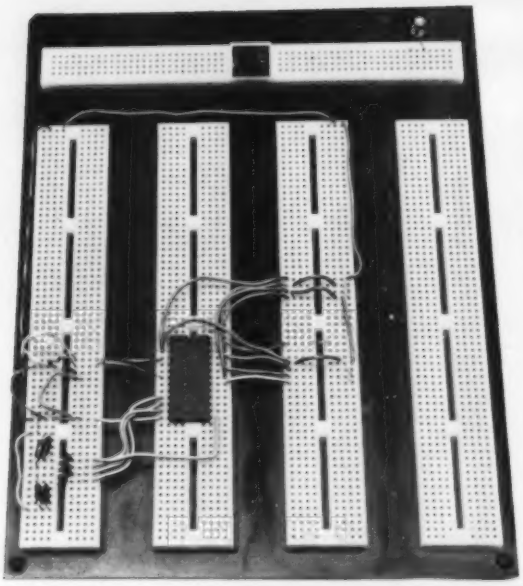

"Hands on" experience in computer arithmetic using a 74182 IC will be the subject of the next article.

By definition, we now have a negative number! We have changed the sign of our number. As can be seen, the right combination of numbers added together will not produce overflow, but will change the sign. Thus, it is also important to test to see if the sign is changed when performing addition on numbers of like sign. If the sign has changed, the 7 bit capability has been exceeded.

In computer logic, it is easy to complement a word such that all ones become zeros and all zeros become ones. This capability is usually a standard feature within the arithmetic-logical unit of a microprocessor. The complement of the eight bit binary number 01001101 would be 10110010. The number 3 represented in 8 bits is 00000011, and the complement of three would then be 11111100. This type of complement where zeros are exchanged for ones and ones are exchanged for zeros is called "ones complement."

By complementing a number using the "ones complement," we have placed a 1 bit or a sign bit in the leftmost bit of the word, indicating that the number stored in the word is a negative number. A typical ALU will complement a word internally, and then perform addition in order to effect subtraction. This might happen as follows, for the operation 7-4:

7 in binary = 00000111

4 in binary = 00000100

The ones complement of 4 (negative 4) = 11111011. Adding the two together,

```
  00000111
  11111011
1 00000010(2) = 2(10)
```

carry bit (overflow)

But the answer is off by one and overflow has occurred. We got an answer of 2; the answer should have been three. This is the shortcoming of ones complement arithmetic, and is the reason all modern computers use twos complement for arithmetic operations and representing negative numbers.

Twos Complement Arithmetic

Twos complement arithmetic operations can be found in all present-day computers, from the lowly 4 bit microprocessor all the way up to the giant large scale systems. The reasons will become evident as we go on and see how effectively negative numbers can be represented in this form.

To find the twos complement of a number, take the ones complement of the number and *add 1*. For example, find the twos complement of 6:

6 in binary	= 00000110
ones complement of 6	= 11111001
add 1	1
twos complement	= 11111010

This value (11111010) represents a *negative six*. Therefore, we can say that when we take the twos complement of a positive number we are changing it to a negative value. To best illustrate that this value is in fact a negative six, let us increment it *six* times (up to zero):

11111010	Negative six
+ 1	
11111011	Negative five
+ 1	
11111100	Negative four
+ 1	
11111101	Negative three
+ 1	
11111110	Negative two
+ 1	
11111111	Negative one
+ 1	
1 00000000	ZERO

Carry discarded

Following are some examples of *subtraction* in twos complement arithmetic:

1. 6-5

5 in binary	= 00000101
ones complement of 5	= 11111010
add 1	1
twos complement	= 11111011

Summing,

6 in binary	= 00000110
twos complement of 5	= 11111011
	1 00000001

A carry is produced, but is discarded. The sign (most significant bit) is zero, indicating the result is positive.

2. 3-3

3 in binary	= 00000011
ones complement of 3	= 11111100
add 1	1
twos complement	= 11111101

Summing,

3 in binary	= 00000011
twos complement of 3	= 11111101
	1 00000000

And, the correct answer is, of course, zero.

3. 3-4

4 in binary	= 00000100
ones complement of 4	= 11111011
add 1	1
twos complement	= 11111100

Summing,

3 in binary	=	00000011
twos complement of 4	=	11111100
		11111111

The result is negative one in twos complement (no carry produced).

In twos complement arithmetic, the addition of two numbers of opposite sign will always produce the correct result. It may or may not produce a carry. The carry or overflow may be ignored.

Notice that, in both ones complement arithmetic and twos complement arithmetic, addition stays the same. The only thing that is changed is the way in which the complement is taken in order to effect subtraction. Some ALUs will compensate automatically for subtraction in ones complement arithmetic, while some won't.

In twos complement arithmetic, the programmer should test for overflow. In any addition of like signed numbers where there is a possibility that the maximum sum could be exceeded, a test must be made for overflow. If the test is not made, there is a danger that erroneous results could occur and that the user might not be aware of that fact. In reality, any addition could produce overflow. While the user may never expect overflow to occur, if his data were erroneous, then an erroneous sum could result. By making the test for overflow under all conditions, those errors "which couldn't possibly happen" would be detected.

All of the examples given here used 8 bit arithmetic to simplify the examples, but the principles and concepts discussed hold true regardless of the arithmetic word length used. On a 32 bit machine, larger numbers can be handled, but the test for overflow (carry) and change of sign must still be made.

Arithmetic Software

Binary arithmetic within a computer is not difficult or mysterious; however, care must be given to making sure that the results obtained from an arithmetic operation are correct. The care required can add additional steps to a program and can conceivably make a simple problem into a lot of work. One way in which some of the work can be eliminated is to choose a microprocessor which provides an automatic "hardware" scheme for testing for overflow or change of sign. Another solution is to choose a microprocessor which provides the same capabilities by software. Software in this case is a program furnished by the manufacturer to do the proper testing for you. This software may also offer the capability to work with 16 or 32 bit numbers and may in addition offer other capabilities such as multiplication and division.

The Next Step

This article avoided some of the more difficult arithmetic operations, such as multiply and divide, in order to dwell on some of the fundamental concepts needed to get "on the air." Multiply and divide can wait for later. If they are needed now, the user can perform successive additions or subtractions as required, or he can use software provided by the manufacturer. These functions will be covered in a later article. It is important at this time to give the experimenter "hands on" experience with computer arithmetic so that experience and confidence can be built up. For this reason, the next article will describe simple experiments with computer arithmetic using a 74181 Arithmetic Logic Unit. These simple experiments will use the concepts discussed in this article and will help the experimenter to better grasp computer arithmetic. ■

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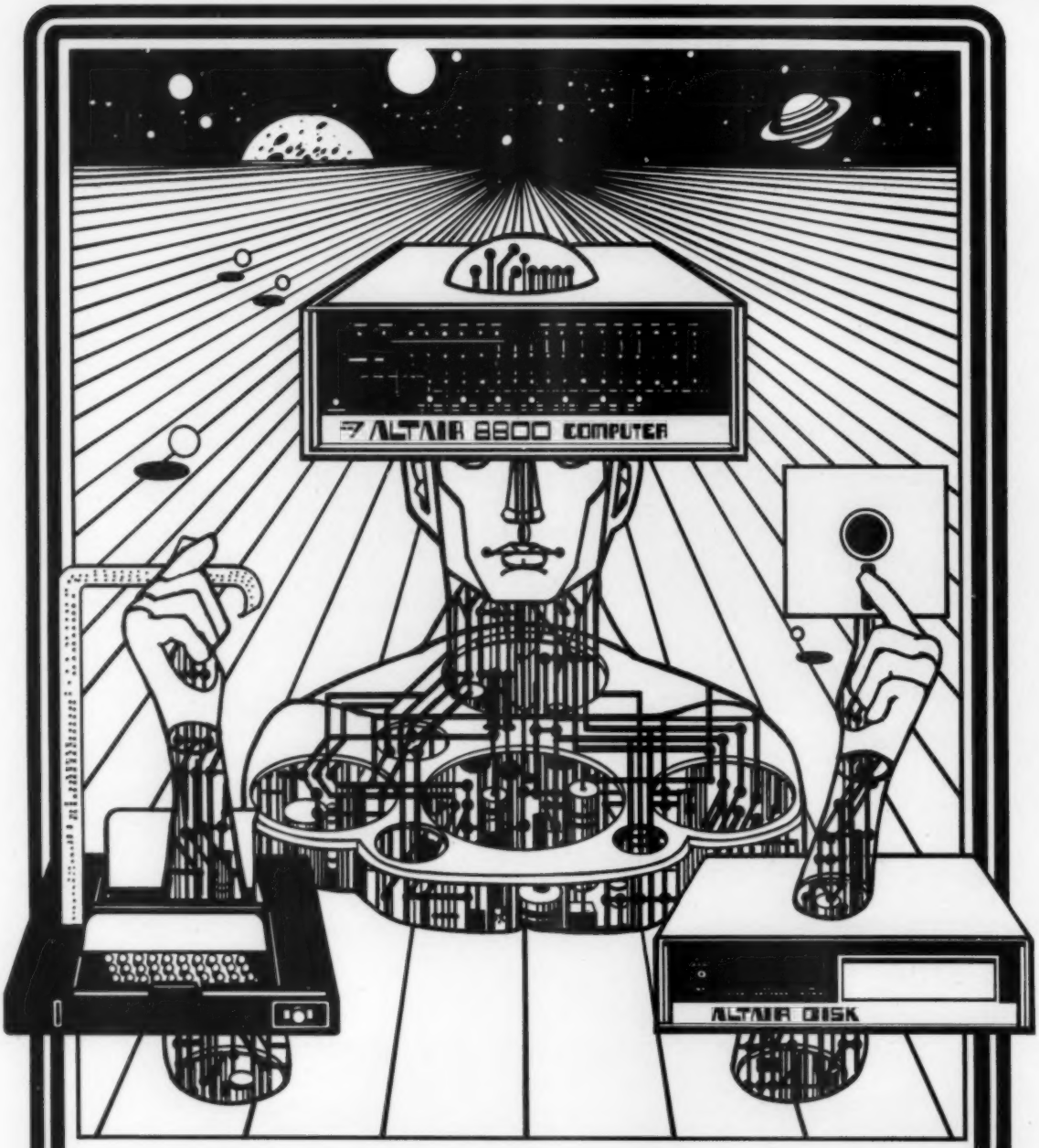

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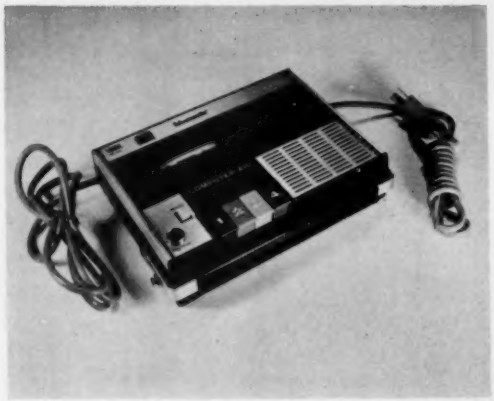

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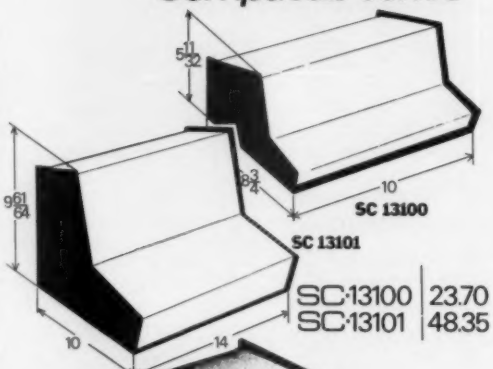
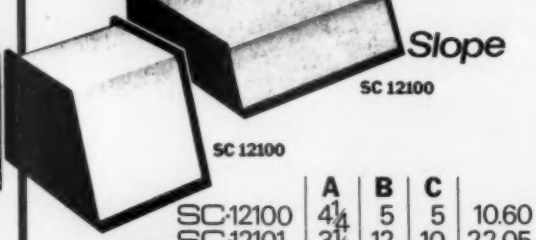
Compucab series



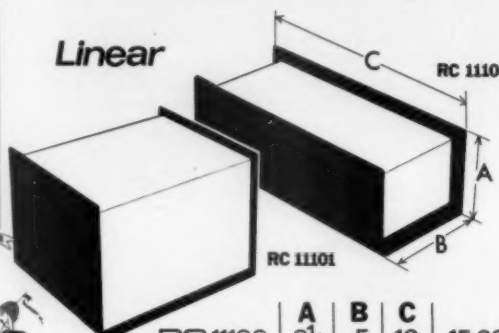
SC-13100	23.70
SC-13101	48.35

Slope



	A	B	C	
SC-12100	4 1/4	5	5	10.60
SC-12101	3 1/4	12	10	22.05

Linear



	A	B	C	
RC-11100	3 1/4	5	10	15.60
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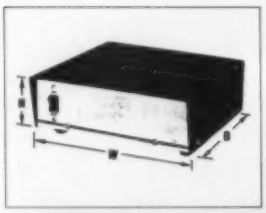

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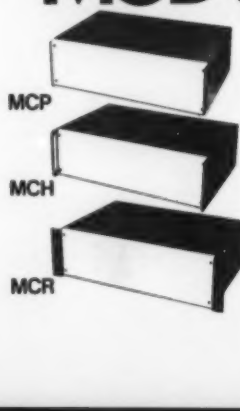

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3-5-7	15.84	5-5-7	16.91	7-5-7	18.70	10-5-7	23.36
3-5-9	16.44	5-5-9	18.00	7-5-9	19.54	10-5-9	25.61
3-5-12	18.91	5-5-12	20.87	7-5-12	22.79	10-5-12	30.54
3-6-5	15.12	5-6-5	16.15	7-6-5	17.95	10-6-5	21.90
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3-7-7	16.96	5-7-7	17.23	7-7-7	18.72	10-7-7	24.02
3-7-9	16.91	5-7-9	18.53	7-7-9	20.04	10-7-9	26.33
3-7-12	20.11	5-7-12	21.71	7-7-12	23.89	10-7-12	31.66
3-8-5	15.52	5-8-5	16.54	7-8-5	17.50	10-8-5	22.62
3-8-7	16.30	5-8-7	17.59	7-8-7	18.13	10-8-7	24.06
3-8-9	17.33	5-8-9	18.85	7-8-9	20.64	10-8-9	27.13
3-8-12	20.34	5-8-12	22.07	7-8-12	24.89	10-8-12	32.62
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3-9-9	17.38	5-9-9	18.12	7-9-9	20.00	10-9-9	27.20
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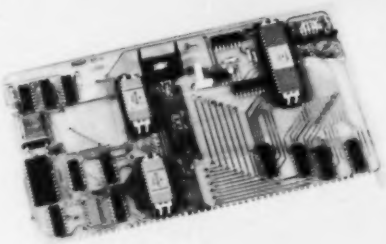

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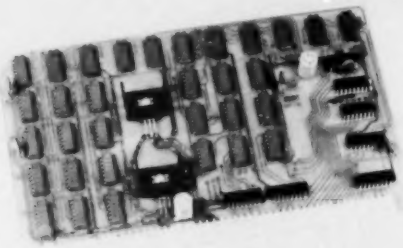

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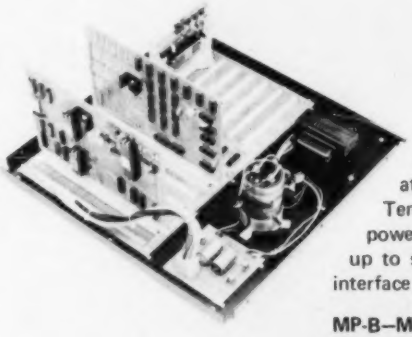

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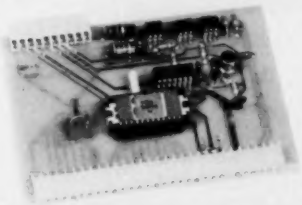

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Those Exciting

Joseph C. Fowler
GTE Lenkurt Demodulator
Assistant Editor

Data processing systems have revolutionized our world, allowing vast amounts of information to be stored, exchanged, updated, and utilized in ways undreamed of a few years ago. A chain of department stores can be tied together, for example, by a data network making current inventory, personnel and credit information instantly available at widely separated locations; a railroad can control activity at its switchyard from a control center hundreds of miles distant; switching functions within a telephone company office can be accomplished rapidly and reliably in accordance with stored program instructions. The information involved in each of these examples is different, but the underlying processing principles are the same.

A digital computer or data processor of any type is basically a stored-program machine, in which a memory facility holds a set of operating instructions — the system program. Information is put into a digital format and fed into the machine, which retains it in a data memory. The instructions in the program memory, which are also in digital form, tell the processor what problem is to be solved, or function performed, related to the input data. When the operations demanded by the program memory have been completed, the data is fed out to be utilized in some manner. In practice, program instructions are often stored within the same memory facility as the data; in this way, the program can also be changed if desired.

Despite surface differences, the ways in which memory facilities receive, hold, and feed out information are all based on either sequential or random access principles.

Sequential Memories

The sequential, or serial, memory method requires that the data bits comprising the information be arranged in a particular order. Data stored in this manner — including both programmed instructions and input information — is retrieved strictly in accordance with its position in a time sequence.

A simple example of sequential memory storage is paper tape, which uses the presence or absence of holes to indicate the condition of a data bit; the combined states of several bits identify a particular digit (see Fig. 1). The tape is moved through a sensing device to convert the hole patterns into a series of pulses for electronic processing. Each piece of information is retrieved as it passes the sensor. Another form of sequential memory storage is magnetic tape, which stores information as magnetic flux variations corresponding to the 1s and 0s of digital data.

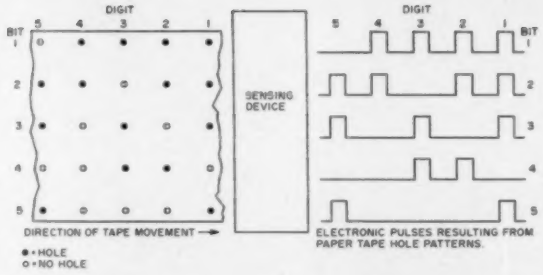

Fig. 1. Paper tape is a form of sequential memory storage, in that the bits identifying a given digit can only be retrieved during their allotted sensing time, which may cause delay in finding desired data.

Sequential access memory systems, including punched cards and magnetic disks as well as tapes, have been widely used in the area of mass computer memories. They typically contain program instructions and must be physically introduced into the processor system — threaded through a sensing device, for example — so that input data can be operated upon. They may also be used to retain the data for future processing. These devices provide a permanent storage capability since the cards, disks, and tapes can be removed and filed for repeated use, and they have non-destructive readouts (i.e., data does not have to be re-entered every time it is used); however, they have some shortcomings which limit their usefulness in high speed memory applications.

For example, sequential access can be a relatively slow process because a large amount of irrelevant data may have to be scanned before the desired bits are found. This delay may be from milliseconds to minutes, which is much too great for many of the uses to which modern data processing equipment is put. Additionally, these sequential

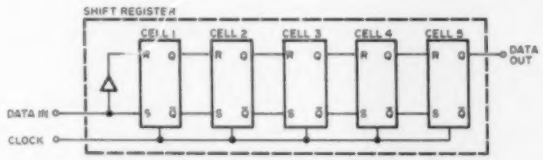

Fig. 2. The shift register, which stores data for as long as it takes for the clock to move it through each cell, is typical of semiconductor sequential memory systems.

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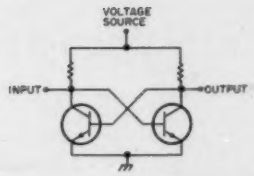

Fig. 3. The bistable multivibrator, or flip flop, has two stable states, making it an ideal digital data memory storage cell.

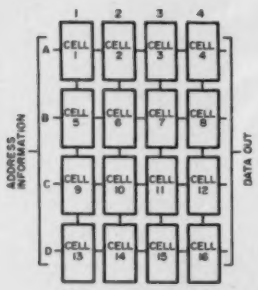

Fig. 4. A random access memory (RAM) is a matrix of memory cells, any of which can be accessed without regard for any other cell.

mass memory systems require a mechanism to move the data-carrying medium past the sensor; this device is of necessity completely mechanical, and is subject to the adjustment and maintenance considerations which apply to all such devices.

uncommon for a data processing system to use tapes and similar elements as permanent, high volume program storage facilities, and semiconductor structures for the "working" memories in which the stored data is operated upon.

The semiconductor devices used in temporary memory structures are typically arranged as groups of individual units called memory cells, each of which stores one bit of information as either a logic 1 or logic 0. A cell may consist of as little as one transistor-capacitor combination, or it may be a complex arrangement of several components. But, whatever its composition, it has at least two states that can represent digital data bits.

shifted from cell to cell in accordance with the clock cycle rate. A logic 1 on the S input of cell 1, for example, will set the flip flop to the 1, or "on," state if a clock pulse is present at input C, thus storing the digit. On the next clock pulse, the stored bit is shifted out of cell 1 to set the second cell to the 1 state, and a new digit is fixed in the first cell. This procedure continues through the register, with the output of the final cell being shifted out for data processing. The clock frequency controls the rate at which the shift register stores and feeds out data bits, with each bit being delayed between input and output by as many clock cycles as there are cells in the register. Since the storage and retrieval are done on a first-in, first-out basis, the shift register is a sequential memory storage device.

Digital data can also be handled by a random access process. This does not mean, of course, that no orderly procedure is involved; it means, rather, that information can be stored in a partic-

Memory Chips

-- RAMs, ROMs, PROMs, etc.

Temporary Memories

Cards, tapes and disks continue to play an important role as high density, long-term mass memory storage elements in such applications as personnel record maintenance, inventory control, and retention of performance data for comparison with future achievements.

For low capacity, temporary memory storage, however, structures composed of semiconductor devices have become dominant in recent years. Temporary data storage facilities are used in such areas as office equipment (calculators, etc.) and immediate-use or "working" memories wherein a data processing device can hold the data with which it is dealing at any given time. It is not

Temporary memories are also widely used in data processing terminals, which serve as remote input/output units for a large central computer and may be in any number of forms, from a simple typewriter keyboard to a small computer. Terminals provide a means of encoding data for manipulation by a central computer, and decoding it for use by a human operator.

Interconnection of central computer and remote terminal is commonly made over telephone lines through an interface unit called a modem, or data set. The data set may also contain a temporary memory facility which allows it to hold data and either condition it for transmission over the lines or prepare received data for application to the processor.

Shift Registers

A shift register is a device for the temporary storage of digital information; when a shift, or clock, pulse is applied, the register accepts new data and moves every stored bit one step toward the output.

Fig. 2 shows an example of a semiconductor shift register containing five memory cells, each of which is a solid state reset-set (R-S) flip flop circuit. Data applied to the register input in a digital form is stored and

ular memory cell, or location, and retrieved without regard for any other location.

Random Access Memory Systems

A random access memory (RAM) can be defined as a structure in which any data bit can be stored (written) or retrieved (read out) in any order.

One of the most basic ways to create a memory cell is through the use of the bistable multivibrator, or flip flop. As shown in Fig. 3, such a memory cell may consist of only two transistors, two resistors, and a power source. In this cell, one or the other of the transistors is always conducting, holding the other one off. When an external signal forces the off transistor into conduction, the initially on transistor turns off and remains in this condition until another external signal resets it. The flip flop, therefore, has two stable states which can be used to store information in the form of logic 1s and 0s.

A RAM is essentially a matrix of such memory cells, with each cell identified by a unique code, or address. The data processing equipment can retrieve a bit of information by addressing the proper location. Because of the matrix structure, the time required to locate any given bit is approximately the same as that required to locate any other bit. For example, in Fig. 4 the digit stored in cell 1, at location A1, could be available at the data output in almost exactly the same time as the bit in cell 16, location D4. This rapid access to information makes the RAM ideal for application as a temporary storage facility.

Random access memory structures are of two basic types: read/write and read only. A read/write RAM is programmable; that is, data can be entered into, changed, and removed from the memory at any time. A read only memory (ROM), however, has certain data patterns fixed into it, usually during the manufacturing process. In such a structure, information can be read out – it will always perform the same function – but the stored program does not change. Because the data pattern is fixed, a ROM retains its program regardless of circuit power considerations; that is, it is a "non-volatile" memory device. A read/write memory, however, needs a constant source of power to remain in operation; if power is removed, the semiconductors stop conducting and the stored information is lost, so the read/write RAM is considered to be a "volatile" device.

Although it is not technically accurate to do so, common usage has led read/write memories to be referred to simply as RAMs, while read only structures – which are, in reality, a type of RAM – are designated ROMs, and this discussion will follow the same nomenclature.

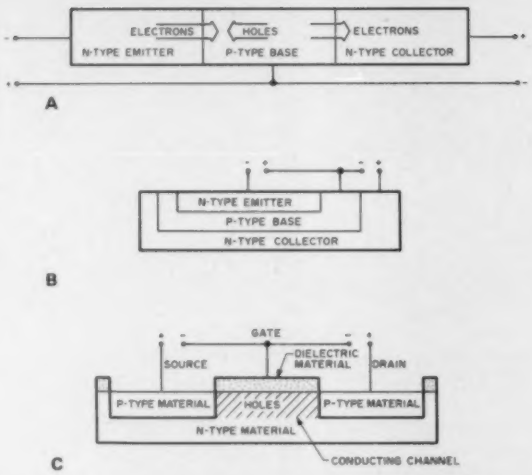

Fig. 5. Bipolar and unipolar transistor structures are the most widely used semiconductor memory cell components.

Bipolar and Unipolar Transistors

The two most widely used devices in memory matrix design today are the bipolar and unipolar, or field effect, transistor. Each can be easily realized as an integrated circuit (IC) component, and they are readily adaptable to virtually any circuit configuration.

Essentially, a bipolar transistor is a semiconductor device whose conductive properties depend upon both majority and minority carriers; that is, current flows in a bipolar transistor because of the simultaneous movement of both positive and negative charges. Negative charges predominate in n-type semiconductor material because there is a surplus of free electrons within the material's atomic structure; p-type material, however, has a shortage of free electrons. The regions in which the electrons would normally exist act as positive, mass-bearing charges called "holes"; p-type material thus maintains an excess of positive charge carriers. The common transistor is a general type of bipolar device, since its current flows due to hole and electron movement. Fig. 5A shows the normal flow pattern within an NPN structure (Fig. 5B shows a bipolar NPN structure as an integrated circuit). The forward-biased emitter-base junction allows electrons to be injected by the emitter into the base region. Within the base, the greater part of the current flow is caused by holes combining with the excess electrons. The reverse bias of the collector-base junction allows electrons to pass into the collector region; because there are two n-type regions, electrons are the majority carriers, although the simultaneous action of the minority carrier holes is indispensable.

The field effect transistor (FET) is a unipolar device, in that its current flow is the result of the movement of only one type of carrier. In what is called the p-channel FET, holes are the majority carriers, while the carriers in an n-channel FET are electrons.

Fig. 5C shows a p-channel FET structure operating in the enhancement mode, which is the most common operating mode for FETs. In this mode, there is no conduction within the device when the gate voltage is zero; the other mode of operation is called depletion, wherein the semiconductor device is always conducting and requires a proper gate-to-source voltage to turn off.

When the gate in Fig. 5C is made negative with respect to the source, it creates an electrostatic field which attracts holes from the n-type semiconductor material toward the area directly below the gate dielectric material. Initially, this n-type area has a surplus of electrons, but as the holes are drawn into it, the electrons are neutralized. At some gate voltage, the holes become dominant and a current-carrying channel is produced between source and drain in which holes are the majority carriers. Because the gate is electrically isolated from the rest of the structure by the dielectric material, there is no current flow into it; the channel, which allows current to flow between

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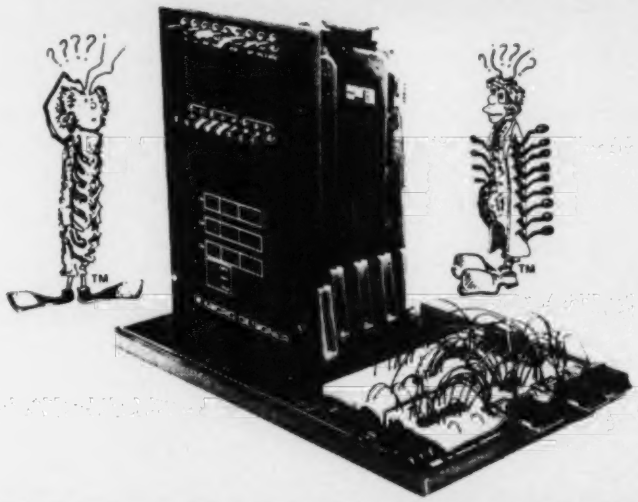

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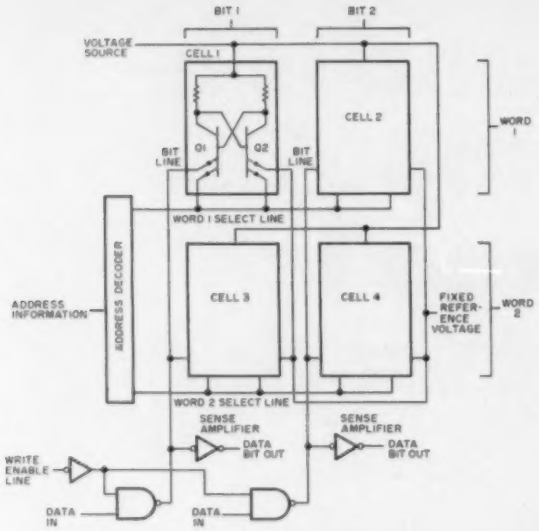

Fig. 6. A 2-word, 2-bits-per-word memory array utilizing multi-emitter bipolar transistor structures.

source and drain, is created and maintained by the electrostatic field.

The need to provide more electronic function in increasingly small areas has resulted in a great variety of miniaturized circuits. Bipolar transistors, for example, can be realized as discrete items, such as those seen in various entertainment products. In data processing applications, however, the large number of components required to produce a memory matrix makes the use of such bulky devices impractical; a circuit board with several hundred discrete transistors mounted on it – which is what a memory matrix would require – would be too unwieldy to be of any real use.

Bipolar Transistor RAMs

Integrated circuit techniques allow quantities of circuit elements to be realized in a small space; these techniques have been used to produce bipolar transistor memories of various microminiaturized sizes and densities.

The basic storage element in these matrices is the bistable flip flop, which appears in many circuit variations to meet different application requirements.

A bipolar RAM cell which has been widely used is the transistor-transistor-logic (TTL) type, exemplified by the multiple-emitter circuit (see Fig. 6). In this case, the data processor applies an address code to a decoding circuit; the decoded address raises the voltage on the correct word select line (places it at a logic 1 level), preparing the cell for the read or write function. A logic 1 bit can be written into the cell, for example, by placing the write enable line at a low voltage (logic 0) level while the data bit input is logic 1. This causes the bit line to be low, turning Q1 on and Q2 off, a state which represents a logic 1 within the cell. Once the write function is complete, the address changes, the word select line returns to a logic 0 state, and Q1 remains on. To read out the stored digit, the address raises the word select line level and the write enable line is held high (logic 1), allowing read current representing the value of the cell's contents to flow into the appropriate sense amplifier for output to the data processor. Because the read process does not change the state of the flip flop, the stored information is not lost and the cell is considered to have a "nondestructive" readout capability.

The 2-word, 2-bits-per-word memory shown in Fig. 6 is, of course, limited in its application. The same addressing, reading, and writing functions, however, are performed in bipolar RAMs containing several times the number of cells. A typical example of expanded capacity is a single integrated circuit capable of storing 16 words of 4 bits each, for a total of 64 bits on one tiny silicon chip. GTE Lenkurt uses nine such chips in both its 262A and 262B data sets. The bipolar RAMs comprise a data memory, in which input data is held to be operated upon. Because of the read/write capabilities of the RAMs, the data being processed can constantly be updated and changed.

Major considerations in memory design include the speed with which a cell can be made to change state (access time) and the amount of power dissipated by the cell's components.

Operating in a saturation mode – in which the "on" transistor constantly conducts the maximum possible current – the TTL-type memory cell requires some amount of time to drive the transistor out of saturation before a change of state can occur. This delay is only on the order of nanoseconds, but is enough to concern circuit designers. In addition, the saturation mode consumes relatively large amounts of power. Two of the more successful configurations developed to overcome these disadvantages are the diode coupled and emitter-coupled logic (ECL) cells.

Diode Coupled RAMs

Two gating diodes are used to control conduction in a diode coupled cell (Fig. 7). In integrated circuits, these diodes are frequently "hot-electron," or "Schottky barrier," devices, which become forward-biased at lower voltages than conventional diodes.

If the state of a cell must be changed to store a bit, the address decoder causes the voltage on the word select line to be forced low, while the voltage is raised on the bit line associated with the transistor to be turned off. Referring to Fig. 7, in which Q2 is hypothetically to be turned off, raising the bit line B voltage and dropping the word select line (effectively making it more negative) draws additional current through R4, increasing the base voltage on Q1 to the point at which it begins conducting. The cross-coupling of the transistors then causes Q2 to turn off, thus effecting the cell's change of state.

Reading the stored digit out of a diode coupled cell also requires that the word select line be forced low, but in this case there is no voltage increase on either of the bit lines. The combined effects of the lowered word select line and a bias network cause the diode associated with the "on" transistor to be forward-biased, causing the diode to conduct. Since the diode associated with the "off" transistor is reverse-biased, a differential voltage develops between the bit lines. A sensing circuit determines the cell's logic state from this voltage.

Read current in a diode coupled cell is greater than standby current, which flows when the cell is storing a bit without being addressed, but is substantially lower than write current. Because of this, the voltage developed across the load resistors during the read operation is not great enough to change the cell's state and the readout is a nondestructive process.

Since standby current is lower than read current and is present a greater percent of the time, overall power consumption in a diode coupled cell is lower than that of a TTL device.

ECL RAMs

The structure of emitter-coupled logic (ECL) memory cells closely resembles that of TTL cells, but biasing techniques are used to keep the transistors out of saturation. This allows the ECL storage element to change state very rapidly; the greatest advantage of ECL over other semiconductor memory configurations is that it has the shortest access time of all. Reading and writing processes are accomplished in essentially the same manner as for TTL, but at a greater speed. Because it constantly draws high current, however, an ECL memory cell has even higher power consumption than TTL, a fact which does impair its usefulness in certain applications.

MOS Technology

One of the major objectives in semiconductor memory design has been to incorporate as much capacity as possible in the smallest area. The greatest size reductions have been achieved with metal oxide-silicon (MOS) techniques, which produce field effect transistor (FET) structures that are considerably more compact than the bipolar integrated circuits (ICs) previously discussed.

An MOS FET is formed by depositing an insulating metal oxide — most often silicon dioxide — on a chip of silicon. Etching processes then remove the oxide from selected areas of the chip, exposing the substrate at source and drain locations while leaving the gate region insulated. Further processing establishes n- and p-type areas within the substrate.

The size reduction possible with MOS techniques allows a much denser memory array to be produced within a given space than is possible with bipolar devices; there are also substantially lower power requirements and reduced packaging costs.

Storage cells composed of MOS FETs may be of either a static or dynamic nature. A static cell retains its stored data as long as power is supplied to the circuit; a dynamic cell depends upon capacitive charge storage to hold its data, and must receive a "refresh" input to counteract the effects of leakage.

Static MOS RAMs

The basic static MOS RAM cell is a bistable multivibrator (see Fig. 8) closely resembling the bipolar flip flop used in TTL memories. In an MOS flip flop, however, transistors serve not only as cross-coupled inverters (Q3 and Q4), but also as load resistances (Q1 and Q2). Electrical isolation of the FET gate results in a very high input resistance which can be controlled by the gate voltage. A large-value resistor can thus be produced by an FET in a relatively small space compared to a conventional resistor.

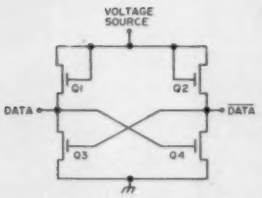

Fig. 8. The heart of the static MOS RAM storage cell is the bistable flip flop composed entirely of field effect transistors (FETs). The logic level at one terminal is always the complement of that at the other.

Since only one of the cross-coupled inverters conducts at any given time, the cell has two stable states which can be used to store information in the form of logic 1s and 0s. The state of the cell is determined by external address and data signals. The cell's state remains constant unless changed by an external signal, so no refresh action is required and the circuitry needed to support the operation of the cell is simplified.

A static MOS RAM storage unit, however, contains a minimum of four transistors, so it occupies a considerable amount of space on a silicon chip and consumes a relatively large amount of power. Because of these disadvantages, static devices have been largely replaced by dynamic MOS RAMs.

Dynamic MOS RAMs

The basic storage element in a dynamic MOS RAM cell is a capacitor, which holds and releases a stored charge in response to read and write commands. While the capacitor could be an external device, it is much more common for dynamic RAMs to utilize the capacitance existing between gate and source of the MOS FET itself. This capacitance is due to the isolation of the gate from the rest of the structure by a dielectric material. Charging the gate-source capacitance sufficiently to turn the transistor on represents a logic 1 state in most applications, while a lower charge or no charge at all serves as a logic 0.

Inevitably, as with all capacitive devices, the charge stored in the gate-source region drains off due to leakage current. If the charge is allowed to deteriorate too much, the data bit is lost, so some means must be provided to periodically restore, or refresh, the charge; a common requirement is that every cell in a memory matrix be refreshed every 2 milliseconds. Circuits to accomplish this are included in dynamic RAM designs, as are address decoding circuits.

The operation of a typical dynamic MOS RAM cell can be illustrated with the 3 transistor cell shown in Fig. 9. In this case, information is stored as a charge in the gate-source capacitance (C_G) of transistor Q2. To write a data bit into this cell, an address decoder produces a write select signal, activating transistor Q1 and allowing data on the write data line to be transferred to the storage element. Depending upon the state of the data input, C_G either charges or is discharged. When the write select signal is removed at the end of the write cycle, the bit is held in the cell.

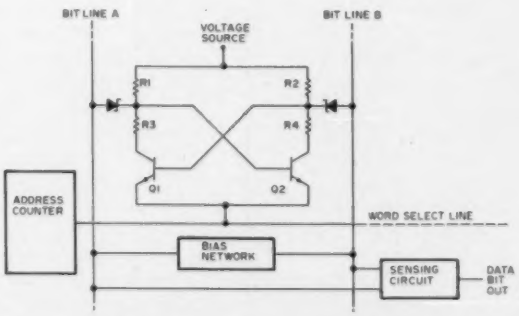

Fig. 7. A diode coupled memory cell uses gating diodes to control conduction and reduce power consumption.

At the beginning of a read cycle, both the read and write data lines are preset to some voltage. When the address decoder produces a read select signal, Q3 is ready to begin conducting. If the charge on C_G is sufficient (logic 1), Q2 turns on and current flows through Q2 and Q3, reducing the voltage on the read data line. With no charge on the capacitance, Q2 and Q3 remain off and the read data line stays at its preset level. Because of the gate isolation, C_G is in the same condition (charged or discharged) at the end of the read cycle as at the beginning, making the read process "nondestructive." An output amplifier senses the state of the read data line and determines what cell condition would produce it (a low-level line generally indicates a stored logic 1) for application to the data processor.

Refresh

Refresh of the stored digit in Fig. 9 is accomplished through a clocked amplifier connected between the read and write data lines. Control circuitry provides the timing necessary to keep the refresh cycle separate from the read and write operations.

The refresh process involves reading out the stored digit and writing it back into the cell. To do this, both data lines are preset at the beginning of the refresh cycle. A read select signal is then produced, transferring the bit to the read data line in the same manner as the normal read operation. The refresh amplifier inverts the condition of the read data line and applies it to the write data line. A write select signal then replaces the read signal and the data present on the write data line is entered into the memory. If, for example, a logic 1 (maximum charge) is stored on C_G, the read data line is forced low (logic 0) when the read select signal forces Q2 and Q3 into conduction. The refresh amplifier inverts this and applies logic 1 to the write data line; the presence of the write select signal causes this data to be written into the cell as a refreshed bit. With no charge (logic 0) on C_G, this sequence is repeated, with a logic 0 appearing on the write data line to ensure that the capacitance is not charged by stray circuit currents.

In Fig. 9, timing from the control circuitry allows a single amplifier to serve an entire column of cells. One alternative configuration uses a common read/write data line. This lets the cell form a loop within itself and thus eliminates refresh amplifiers.

ROMs

A read only memory (ROM) is a data storage facility into which information is normally written only once. After this entry, a ROM always produces the same output when addressed.

The difference between the read/write RAM and the ROM can perhaps be best illustrated with the example of the pocket calculator. In almost all calculator designs, a RAM matrix serves as a "working," or data, memory and ROMs are used for input/output interface, timing control and program storage (see Fig. 10).

Each key on the calculator keyboard is identified by a unique binary number; all of these numbers are permanently fixed in the ROM encoder so that, when a key is pressed, the corresponding binary number appears as the encoder output. If a digit key is pressed, the bits comprising the number are written into the RAM data store. Function key (addition, subtraction, etc.) numbers are applied to the ROM program store as addresses. In the program store are contained instructions for each function; when an address is presented, the proper instructions are read out of the ROM, leading to performance of the desired operation upon the data held in the RAM. When the function has been completed, the result is read out and applied to the decoder, which puts it into a form suitable for display.

The basic ROM structure is a matrix of elements, each of which is accessed by a random address code, allowing approximately equal access time to all bits. The simplest ROM structure is a network of diodes wherein the presence or absence of a diode determines the logic state of a particular location; such a network is shown in Fig. 11. The row address decoder raises the voltage on the appropriate word line to a high positive level, forward-biasing the diodes attached to that line. When the diodes begin conducting, they force their associated bit lines to a high (logic 1) level, while bit lines not connected to diodes remain low (logic 0). Output amplifiers sense the state of each line and present the bits to the data processor's other circuitry.

For example, if the row address decoder raises the word line 1 level, diodes D1, D2, and D3 conduct, raising bit lines 1, 2 and 4. In this case, the matrix output would be the binary number 1101. The next address might raise word line 4, in which case the output would be 0110. In some applications, column (bit line) addressing is added to select fewer than the maximum possible bit outputs.

ROM matrices are also formed with bipolar and MOS devices. In the most common configurations, the presence or absence of conductors establishes logic states.

Fig. 12 shows a ROM matrix utilizing multiple-emitter bipolar transistors. In this case, the collectors are used as row enabling contacts, replacing the word lines, and emitter contacts are omitted from selected locations to set logic levels. When the row address decoder raises the voltage on the appropriate collector to a

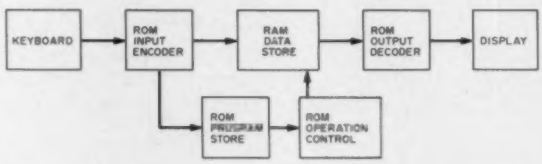

Fig. 10. A pocket calculator typically utilizes both RAM and ROM facilities to process input data.

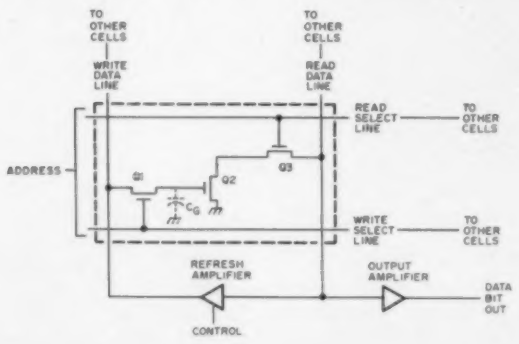

Fig. 9. A dynamic MOS RAM cell stores data in the gate-source capacitance of one of its transistors.

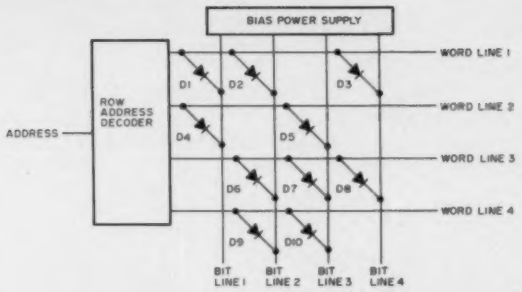

Fig. 11. A diode network with random access addressing is the simplest type of semiconductor ROM.

sufficiently high level, the transistor segments with emitter contacts begin conducting: for example, if Q2 is selected, the matrix output is 1001 (the level of columns 1 and 4 raised by conduction, 2 and 3 remaining low). In Fig. 12, column address and data output decoding selects two of the four bits for application to the processor.

In Fig. 13, a ROM matrix composed of static MOS FET devices is shown. Logic states are determined by the presence or absence of gates within the transistor structures. Reading this memory is accomplished in the same manner as diode and bipolar ROMs, except that the bit lines are driven low (to ground) when the FETs conduct.

Programmable ROMs

Semiconductor memories are almost universally formed on minute silicon chips capable of holding large numbers of integrated circuit devices; the chips often contain complete addressing, decoding, and output circuitry in addition to the memory cells.

In the formation of standard ROM matrices – in which the stored data is never to be changed – logic states are established during the manufacturing process by omitting the proper elements to create the desired bit pattern. This is the most prevalent type of read only memory. There are cases, however, in which standard memories are not available to meet application requirements, so programmable ROM (PROM) matrices are also produced.

A PROM is essentially a semiconductor matrix which has its program written into it at some time other than the manufacturing process. The manufacturer provides a chip on which all of the rows and columns (word and bit lines) are linked by conducting devices. Before integrating the chip into a circuit, the purchaser of the PROM uses various techniques – from application of a high-level write current to a laser beam – to eliminate devices from the matrix. In this way, a stored program unique to a given application can be produced.

New Developments

This discussion has covered structures that are representative of devices currently used in data processing memory facilities, and has not attempted to consider all of the variations of the basic structures. Advances are being made at a remarkable rate, and today's technology may be totally obsolete in a few years. Among the new memory devices that may bring this about are charge coupled devices (CCDs), bucket brigade devices (BBDs) and magnetic bubbles. Charge coupled and bucket brigade devices are similar in that both store digits as the presence or absence of electric charge.

A basic CCD is a semiconductor chip – either n- or p-type – over which a dielectric material is laid. A series of gate contacts are placed along the dielectric. Charge is stored as minority carriers under the gate regions. When the substrate is p-type, for example, applying a positive voltage to one gate attracts electrons out of the substrate until they dominate in the area directly beneath the gate, forming a "potential well." This storage condition is maintained for times up to several seconds after the gate voltage is reduced. Raising potential on the next gate in the series forms a second potential well into which the stored charge is transferred; gate potentials are sequentially raised by a clocked voltage to move the stored bit through the device. The CCD is thus a sequentially accessed memory facility similar to the shift register.

The movement of charge in a bucket brigade device is the same as in the CCD. Potential wells, however, are replaced by "buckets" of material unlike the substrate; for example, n-type areas may be embedded beneath the gates in a p-type chip to act as MOS storage capacitors.

Fabrication techniques currently limit the production of CCDs and BBDs, but they hold the promise of extremely small, very fast, low power memories of high density, and many manufacturers are investigating their commercial feasibility.

Magnetic bubble technology is still in the developmental stage, but it also shows great promise. The bubbles, which are tiny, mobile particles whose polarity is opposite to that of the thin film containing them, can be arranged to form coded data patterns, thus providing a storage medium.

Conventional bipolar and MOS devices are being modified to achieve an optimum combination of memory cell size, speed and power consumption. N-channel and p-channel MOS FETs are being combined on one chip as complementary MOS (CMOS) devices for low power applications, and Schottky diodes are being introduced into various bipolar configurations to decrease power consumption and increase speed. One such modification has resulted in the low power Schottky TTL memory cell, which has access speed approaching that of ECL (the fastest presently available cell type) and power requirements close to those of MOS FETs; GTE Lenkurt uses this family of devices in its 262A and 262B data sets to achieve the most rapid data processing possible with the least power. In another development, metal-nitride oxide semiconductors are being looked at as possible non-volatile read/write RAMs (memory facilities which

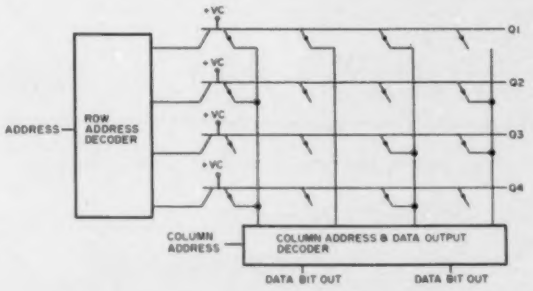

Fig. 12. Bipolar read only memory matrix.

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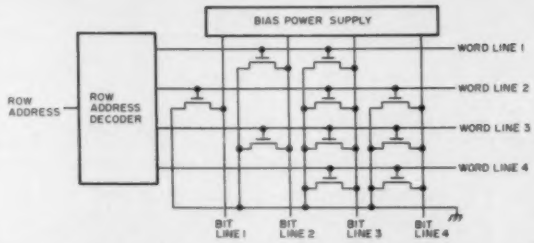

Fig. 13. The logic states within a static MOS RAM are determined by the presence or absence of gate contacts.

would not lose stored data when power is removed).

Whether improvements to existing structures continue at the present rate, or new technologies take over completely, there is no doubt that semiconductors will play an increasingly important role in data processing systems. ■

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This translator will accept a dot/dash ratio from 1:2 to 1:4 (1:3 is nominal for International Morse Code) with any ratio of letter speed to spacing (i.e., 25 wpm characters spaced out for 10 wpm) because mark and space timing are evaluated separately. A speed variation of ±20% per character can be followed without error. Larger variations require from three to ten characters at the new speed to regain lock. Word spacing is also provided, and carriage return is adjusted to avoid breaking up words at the end of lines.

Due to its simplicity, this translator can be assembled in only an hour or two. Circuit boards and components are available, as well as preprogrammed ROMs and complete programming information (see Parts List).

This machine is based on the MOS Technology MCS 6502 microprocessor. This device offers several features which make it attractive for this application: low cost, fast cycle time, on-chip clock oscillator, and single +5 volt power supply. Bus organization is the same as the M6800 and offers simple memory-I/O interface with a minimum of external parts.

The entire system includes a CPU (the microprocessor), a 512 x 8 ROM containing the program, a 128 x 8 RAM, an interrupt timer, and three TTL chips which provide a 1-bit input port, a 1-bit output port, and an interrupt control flip flop. No UART or other parallel to serial converter is needed since this function is provided by the software. The output port feeds the display device directly in serial form. The output data rate is controlled by the interrupt timer, and can be varied to suit the display used.

The complete schematic is shown in Fig. 1. Although it may look intimidating, most of the wiring is just parallel runs from chip to chip. Pins 26 through 33 of Z1 are the data bus over which instructions and data flow between the CPU and the other chips. The address of instructions, memory locations and I/O ports are output on the address bus, pins 9 through 20. The R/W line signals whether data is being read into or written out of the processor. Z5A and Z4B form a 1-bit output port which is connected to data bus 0. Z5B, Z6A and Q2 are used as an input port, driving data onto data bus 7. The 555, Z7, is an interrupt timer. Each time it clocks, the execution of the program is suspended and a new output bit appears at pin 5 of Z4. By varying the rate of the interrupts, the output rate may be set to any desired speed. More detailed information on the 6502 microprocessor is contained in the two excellent manuals available from the manufacturer (see Reference List).

The program is contained in the ROM, Z3. It is an Intel

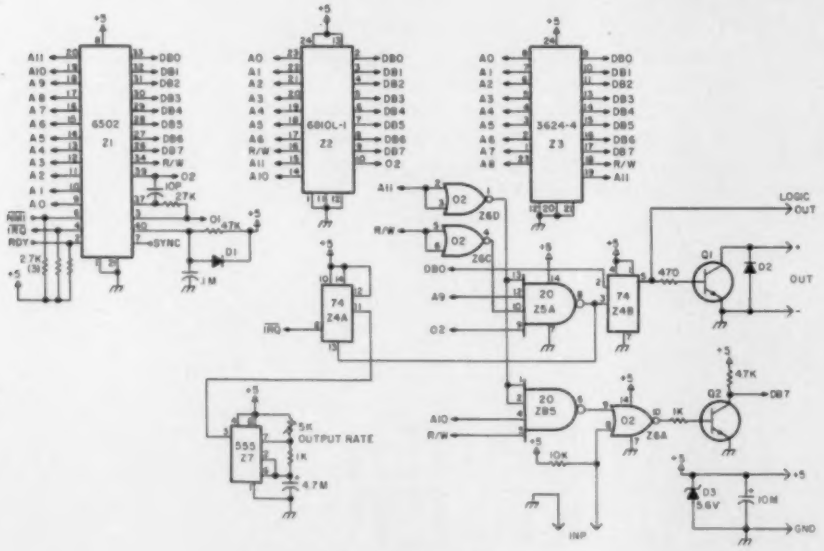

Fig. 1. Schematic.

D-3624, which is a fusible-link, bipolar, tri-state, 512 x 8 PROM. A complete program listing with notes is available, as well as pre-programmed PROMs. Basically, the dot-dash threshold is set equal to half the mark period if the element was a dash, or to twice the period if it was a dot. Thus, the threshold varies between 1/2 and 2/3 of dash time. This provides a tolerance in dot-dash timing, and makes the threshold follow the input code speed. A similar method is used for spaces. Word spacing threshold is initially set for 1-1/2 times the letter space. If more than eight characters are received without a word space, the threshold is decreased. If more than four characters are received with spaces between each, the threshold is increased. This process is iterated until proper spacing is achieved. A counter keeps track of how many characters have been printed in each line. At the first word space following the 64th character, a CR-LF-LTRS sequence is output. This can be easily modified for other printer or display widths, or bypassed entirely by minor changes in programming.

The input is sampled periodically by a software loop, which simultaneously increments a counter. When the input changes state, the elapsed time is represented by the number in the counter. The program processes the timing data, and then begins the timing loop over to wait for the next input change. The output is interrupt driven. Each time a new output bit is due, the timer Z7 clocks Z4A which in turn pulls the $\overline{IRQ}$ line of the CPU low. The microprocessor suspends whatever operation is being executed at the time, and jumps to a subroutine which outputs a new bit via Z4B. It then returns to the main program to resume operations. This procedure requires only 50 to 60 microseconds to complete, so there is no noticeable slowing of the main program execution. Part of the RAM is assigned as a FIFO buffer to accommodate situations such as upper case (FIGS-Char.-LTRS) or end of line (CR-LF-LTRS). In these cases several output characters are output very quickly, and the buffer stores and feeds them out sequentially at the TTY output rate.

Parts List

Z1	MCS6502 (MOS Technology)
Z2	MC6810L-1 (Motorola)
Z3	D-3624-4 (Intel)
Z4	SN 74LS74 N
Z5	SN 74LS20 N
Z6	SN 74LS02 N
Z7	NE 555
Q1	2N5682 (Motorola, any 100 mA, 150 volt NPN silicon)
Q2	2N3904
D1	1N4148
D2	1N4004
D3	5.6 volt 1 Watt zener
1	470 Ohm 5% ¼ Watt composition resistor
2	1k Ohm
3	2.7k Ohm
1	10k Ohm
1	4.7k Ohm
1	27k Ohm
1	47k Ohm
1	10 pF ceramic NPO
1	4.7 mF 10 volt tantalum
1	10 mF 10 volt tantalum
2	.1 mF ceramic

Misc. sockets, terminals, circuit board

The following items are available from: Levy Associates
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Kit of all ICs, electronic parts, pre-programmed ROM, sockets, double sided plated through circuit board (4 x 6")	$139.00
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Complete program listing and notes (supplied free with any above)	$ 3.50

Special programming also available — write describing options needed.

Assembly

Construction is simplified by using the available circuit board, which is double sided with plated-through holes. However, wire wrap is also satisfactory. Lead dress is not particularly critical, except pins 39, 37 and 3 of Z1 and to the 10 pF capacitor and the 27k resistor. These are connections for the clock oscillator, and pickup can cause frequency modulation of the clock, which can cause some very strange problems. Reasonably short ground leads should be provided. Z3 in particular draws several hundred milliamps and should have appropriately heavy supply connections.

Be sure to use sockets for all of the ICs. They must be inserted at various points in the checkout procedure. After mounting the sockets, they should be broken in by using the pins of a spare 14 or 16 pin IC. Insert and remove these pins at least once in each receptacle of the sockets, being sure to catch all of the pins of the 24 and 40 pin sockets. This reduces the insertion force required, and lessens the chance of bent pins and broken ICs.

A limited amount of parts substitution can be made. The 6810 must be a -1

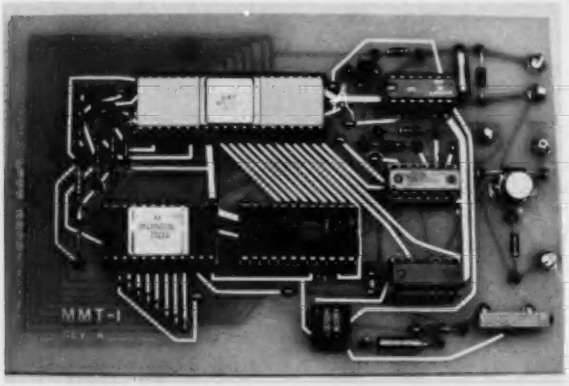

Fig. 2.

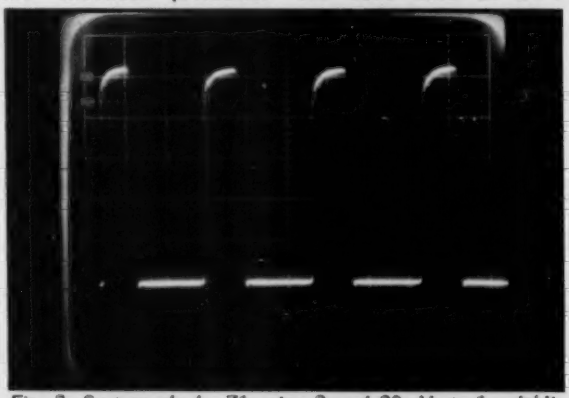

Fig. 3. System clock. Z1, pins 3 and 39. Vert: 1 volt/div. Horiz: 0.5 usec/div.

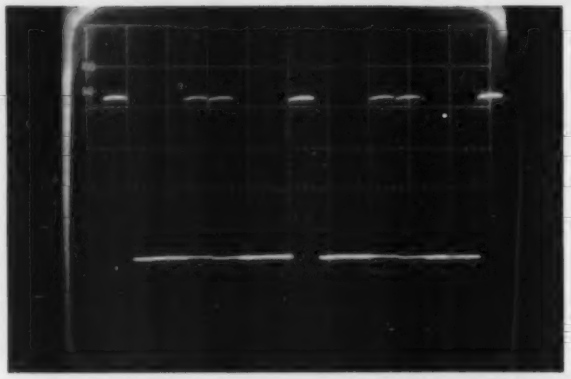

Fig. 4. Sync, Z1, pin 7. Vert: 1 volt/div. Horiz: 2 usec/div.

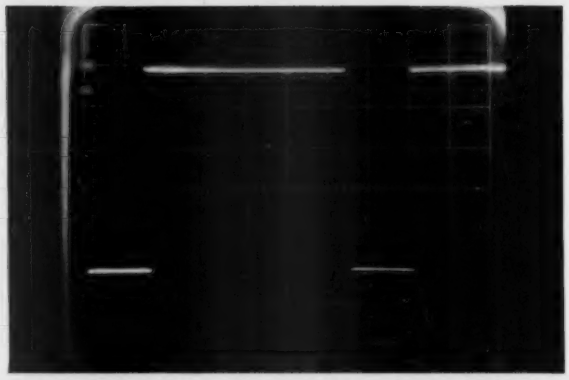

Fig. 5. Interrupt timer. Z7, pin 3. Vert: 1 volt/div. Horiz: 2 ms/div.

version, and the TTL must be low power Shottky to avoid excessive loading. The D-3624 can be either a standard or a -4 version, or a D-3604 can be substituted if eight 10k pull-up resistors are added to the data bus lines. Care should be taken to do the wiring with no mistakes. These components include relatively expensive MOS devices, which are not nearly so forgiving as TTL. Reversed polarity and shorted outputs can be disastrous. NOTE: Do not solder any part of the board without removing Z1 and Z2 first. Do not remove or insert any ICs while power is applied.

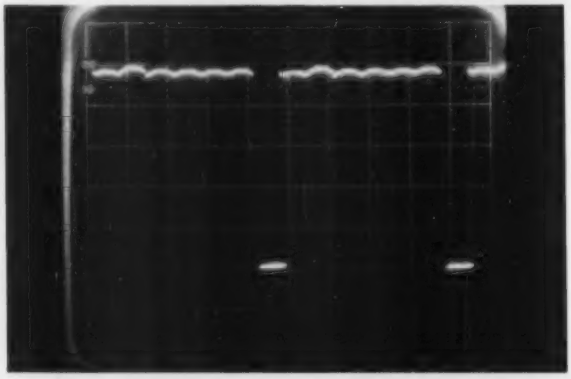

Fig. 6. Input sample pulse after 5 seconds. Z5, pin 6. Vert: 1 volt/div. Horiz: 2 usec/div.

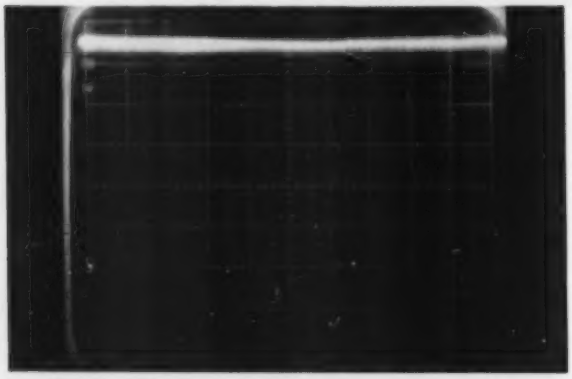

Fig. 7. Interrupt request, $\overline{IRQ}$, Z1, pin 4. Vert: 1 volt/div. Horiz: 2 ms/div.

Testing

A five volt, 400 mA current limited power supply and a 10 MHz scope, preferably dual trace, triggered sweep, are needed for testing. It should be noted that several of the ICs will get quite warm during operation. Z2 and Z3 will be almost too hot to touch after an hour of operation. The others will be slightly warm.

Remove all of the ICs and apply power. Check each socket to verify that +5 volts and ground appear on the correct pins.

Remove power and insert the 6502, Z1. Handle the 6502 by the pins in one hand and support the board on the other while inserting the chip. The conductivity of your body will keep static charges from damaging the MOS circuit. Be careful not to bend any of the pins. For all of the larger ICs it may help to carefully bend the leads on the two sides until they are parallel, to ease entry into the sockets.

Connect the scope to pin 3 of Z1, and apply power. An approximate square wave of about 750 kHz (±30%) should appear (Fig. 3). A similar waveform should appear on pin 39.

Move the scope to pin 7 of Z1. Using a clip lead, momentarily short the anode of D1 to ground. A burst of 1 to 2 microsecond pulses should appear (Fig. 4). The duration of the burst may be from a few milliseconds to continuous. Each pulse signals a new instruction being fetched by the microprocessor. Since there is no ROM to supply instructions, it executes essentially a random sequence, which usually "blows up" and stops executing after a period of time.

Next, insert Z2, the 6810-1, being sure to power off first. Use the same technique as for the 6502. Reapply power, and make the same test as before. The same results should be observed.

Insert the 555, Z7. On pin 3 of Z7 a pulse train will appear (Fig. 5). Set the trim pot for the time period corresponding to the desired output TTY speed from Fig. 10.

Insert the 74LS02, Z6, the 74LS20, Z5, and the D-3624 ROM, Z3. Connect the scope to pin 7 of Z1. You should see a series of 1 microsecond pulses of irregular spacing (Fig. 4). Connect the scope to pin 6 of Z5. Momentarily short the anode of D1 to ground. Immediately following, a 1 microsecond pulse with a repetition rate of approximately 7 milliseconds should appear. This is the input sample rate. After a few

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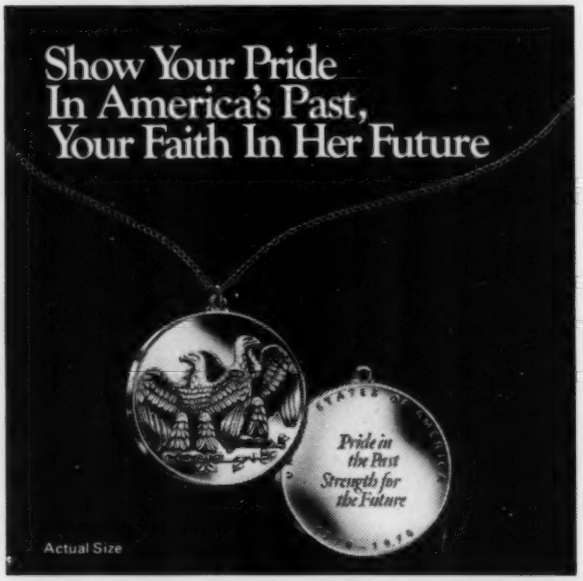

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6

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Name _____

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seconds, it will change to a repetition rate of 8 microseconds (Fig. 6). Each time the system is reset, either by shorting D1 or by reapplying power, this pulse should repeat the same slow, then fast, repetition rate sequence. At this point the CPU is fetching and executing instructions properly.

Insert Z4, the 74LS74. Connect the scope to Z1, pin 4. A negative-going pulse of approximately 50 microseconds duration should appear, with a repetition rate equal to the period set by the trim pot earlier (Fig. 7). Careful examination of this pulse will show some jitter in its width (Fig. 8). This amount should be less than 1% of the pulse to pulse spacing.

Connect a key from the input to ground. (If a keyer is used, be sure it is set up to switch positive voltages to ground.) Put the scope on the logic output pin. Set the timebase to 20 milliseconds/division. Send CQspaceCQspaceCQspace . . . After a few characters, the beginning of each character should trigger a series of pulses (Fig. 9), with the series following the space being twice as long (because it is Character-Space sequentially). These series of pulses are the serial TTY output.

Connect the TTY machine or display as shown in Fig. 11. Be sure to watch polarity and grounds. Fig. 11 also shows the configuration for TTL compatible outputs. Now the machine should print the correct translation of the input code. Word spacing will take three or four words to settle down. An automatic CR-LF-LTRS sequence will be output after the first word space following the 64th character of each line. Unless an unusually long word (such as microprocessor) is sent, this will prevent breaking up of words.

Speed (wpm)	Z7 Period
60	22.22 ms
66	20.20 ms
75	17.78 ms
100	13.33 ms

Fig. 10. Z7 timing period for TTY output speeds. One new bit is output for each pulse for Z7. Higher speeds can be obtained by changing the timing components.

Fig. 8. Interrupt request, $\overline{IRQ}$, Z1, pin 4. Vert: 1 volt/div. Horiz: 20 usec/div.

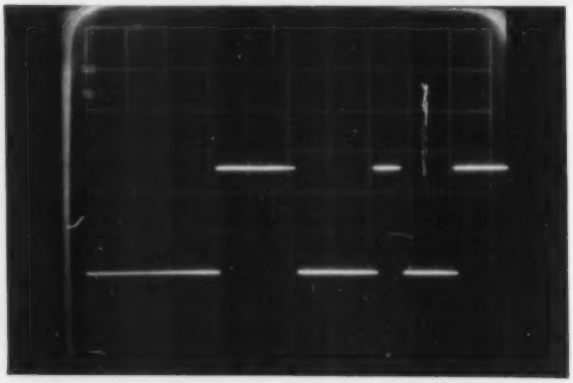

Fig. 9. Logic output. Vert: 1 volt/div. Horiz: 20 ms/div. This is the serial TTY output (set for 100 wpm).

The printer will normally be one character behind. This is because it is still measuring the space until the next mark comes along. Each character will be output as soon as the following one starts.

There is a built-in buffer of approximately 40 characters which is designed to accommodate extra characters like FIGS, LTRS, CR, LF, etc. It will also allow input code speed to exceed TTY output speed for a brief time. The speed range is limited on the high end by the TTY machine speed used. For a 60 wpm printer, it will limit at about 50 wpm code speed, and for a 100 wpm printer, about 65 wpm code speed. A programming change to increase the sample rate used at the input will allow a higher upper limit, with a corresponding increase of the minimum from the normal 5 wpm.

There are two things to check in case of difficulty. First, be sure you are not running your letters together. It is a natural tendency to try to send as fast as possible to test this type of system, and this usually results in running letters together. Remember, the machine is relatively dumb, and doesn't know that — . . . . is really "the" and not "6" because you don't say "6 real thing."

The delayed audio feedback caused by the printing delay can also raise havoc with your timing. A pair of headphones or a silent printer is the cure.

The other thing to check is that the output speed is set carefully to match the TTY machine speed (within 1%). A clue to mismatch here is consistent errors such as extra Ts after, or instead of, spaces, or CR instead of spaces, etc. Also check to be sure the loop supply being used is compatible with the TTY machine. Newer models are fairly tolerant of open circuit voltage and exact current, but older machines are not. Substituting a keyboard for the translator is a quick way to check this.

Conclusion

Your Morse code translator will now operate from a key or keyer. I will be happy to attempt to assist in case of difficulty, but please send an SASE. ■

Reference List

1. MCS 6500 MICROCOMPUTER FAMILY PROGRAMMING MANUAL, August 1975, MOS Technology Inc., Norristown PA.
2. MCS 6500 MICROCOMPUTER FAMILY HARDWARE MANUAL, August 1975, MOS Technology Inc., Norristown PA.

Both of the above manuals are available for $5.00 each from MOS Technology Inc., 950 Rittenhouse Road, Norristown PA 19401.

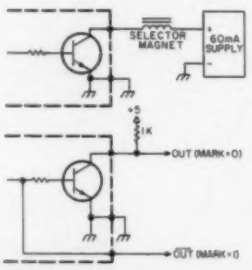

Fig. 11. Output connections.

Stay tuned for future programs.

The HAL ST-6000 demodulator /keyer and the DS-3000 and DS-4000 KSR/RO series of communications terminals are designed to give you superlative TTY performance today —and in the future. DS series terminals, for example, are re-programmable, assuring you freedom from obsolescence. Sophisticated systems all, these HAL products are attractively priced—for industry, government and serious amateur radio operators.

The HAL ST-6000 operates at standard shifts of 850, 425, and 170 Hz. The tone keyer is crystal-controlled. Loop supply is internal. Active filters allow flexibility in establishing different tone pairs. You can select AM or hard-limiting FM modes of operation to accommodate different operating conditions. An internal monitor scope (shown on model above) allows fast, accurate tuning. The ST-6000 has an outstandingly high dynamic range of operation. Data I/O can be RS-232C, MIL-188C or current loop.

The DS-3000 and DS-4000 series of KSR and RO terminals provide silent, reliable, all-electronic TTY transmission and reception, or read-only (RO) operation of different combinations of codes, including Baudot, ASCII and Morse. The powerful, programmable 8080A microprocessor is included in the circuitry to assure maximum flexibility for your present needs —and for the future. The KSR models offer you full editing capability. The video display is a convenient 16-line format, of 72 characters per line.

These are some of the highlights. The full range of features and specifications for the ST-6000 and the DS series of KSR and RO terminals is covered in comprehensive data sheets available on request. Write for them now—and tune in to the most sophisticated TTY operation you can have today...or in the future.

HAL

HAL Communications Corp., Box 365, 807 E. Green Street
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John Isaacs W6PZV
3175 Val Verde Ave.
Long Beach CA 90808

Number Systems

-- a brief history

Have you ever wondered about the term "binary number" that you have seen in electronics magazines? Since we already have a perfectly good decimal number system, why complicate things with another? If you have a few minutes, here is your chance to learn more about number systems than you ever wanted to know.

One of the most important achievements in the development of science has undoubtedly been the invention of our decimal number system. Counting in units of ten must certainly be due to the fact that man has ten fingers. In some cases, some people have counted in units of five or twenty, which correspond to the use of one hand or of both hands and both feet.

The main use of numbers in early times was for simple counting and record keeping. The numeration methods were designed chiefly for those purposes. With the development of trade and the sciences, the numeration became more and more inadequate. It took a long time before an adequate number system was devised. The Greeks and the Romans did not succeed in this endeavor even though they achieved a rather high development in science. Just imagine performing simple arithmetic with Roman numerals, like dividing MMDXLVI by CCIX using Roman numerals only. About six hundred years ago any simple operations like multiplication and division of large numbers required the services of an expert.

The Hindus and the Arabs are credited with the concept of positional value and the use of the zero, which are explained as follows. Consider the number 74638. We understand this to mean 7 x 10,000 + 4 x 1,000 + 6 x 100 + 3 x 10 + 8 x 1. In the following numbers, the 4 has different values depending on its position: 42,000, 240, 324. In the first number 4 is equal to 40,000, in the second its value is 40 and in the last just 4. Without a 0 to place in some of the positions, how would you write three hundred and six if every position had to have a number? Use of the concept of zero enables us to write 306.

The positional values of the base ten number system are as follows:

$$10^3\ 10^2\ 10^1\ 10^0.\ 10^{-1}\ 10^{-2}\ 10^{-3}$$

You will note that in each case the value of the position is the radix (10) raised to some power. It is necessary to go to the right of the radix point (decimal point) in order to express fractional numbers.

The general expression for a number is then:

$$N = a_1(r)^{n-2} + a_2(r)^{n-3} + a_3(r)^{n-4} + a_4(r)^{n-5}$$

In the above expression r is the radix or number base and the a values are the position numbers. In order to have a base ten number system that will translate most practical numbers we would have to make n = 5. Using the arbitrary number 2307.602 as an example, and making n = 5, we derive:

$$2(10^3) + 3(10^2) + 0(10^1) + 7(10^0) + 6(10^{-1}) + 0(10^{-2}) + 2(10^{-3})$$

Note that any number raised to the zero power is equal to one (i.e., $10^0 = 1$).

Now we can calculate the positional values for the binary (base 2) number system. They are as follows:

$2^0 = 1$
$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$
$2^6 = 64$
$2^7 = 128$
$2^8 = 256$
$2^9 = 512$
$2^{10} = 1024$

$2^{-1} = .5$
$2^{-2} = .25$
$2^{-3} = .125$
$2^{-4} = .0625$
$2^{-5} = .03125$
$2^{-6} = .015625$
$2^{-7} = .0078125$
$2^{-8} = .00390625$
$2^{-9} = .001953125$
$2^{-10} = .0009765625$

We now have the conversion factors necessary to convert a binary number to a decimal number.

Let's consider the base 2 number 0011100.0 and calculate its decimal equivalent.

0 x 1 = 0
0 x 2 = 0
1 x 4 = 4
1 x 8 = 8
1 x 16 = 16
0 x 32 = 0
0 x 64 = 0

28 (base 10) = 0011100.0 (base 2)

It may not have been apparent from the preceding, but the fact is that binary numbers are made up of 1s and 0s only. If we were to design an electronic computer or calculator to use the decimal number system, we would find that the decimal number system was capable of the high speeds that are necessary — but it would be very difficult to provide ten stable states so that the computer could handle the decimal numbers. Fortunately, any number can be represented in the binary number system, so computers are designed to use it. They might also use the base 8 or base 16 number systems,

since these have similar properties.

Electronic circuits have been devised that will add, subtract, multiply, and divide in the binary number system. If you are interested in these processes you could consult any text on computer design. Several are listed in the references at the end of this article.

Just to stimulate your interest in the binary number system, let's try working a problem. First we need to know that in the binary system 1 + 1 = 0 plus a carry. The carry is into the next position (or 2^1) so that properly 1 + 1 = 10. This happens in the decimal system also; for example, 9 + 9 = 8 plus a carry into the 10^1 column, so that 9 + 9 = 18. Now let's try out your new understanding of number systems on this little problem. Calculate the first five positional values to the left of the radix point in the base 8 number system (remember, 8^0 + 1). Then calculate the decimal equivalent of the octal number 40. The answers follow the references.

Now that you are up on number systems, you don't have to skip over the articles that refer to the binary number system. Things like electronic keyers use them, especially if there is a memory involved. A lot of the integrated circuits manipulate them also. Have fun! ■

References

Hallerman, *Digital Computer System Principles,* McGraw-Hill.
Hawkins, *Circuit Design of Digital Computers,* John Wiley & Sons.
Lebow and Reed, *Theory and Design of Digital Machines,* McGraw-Hill.
Ledley, *Digital Computers and Control Engineering,* McGraw-Hill.

● Answers: 1, 8, 64, 512, 4096; 32.

LETTERS

ou goons don't ever
I insist that you print ev

from page 12

completed board. Just use good quality black type of whatever style turns you on.

Thanks once again, Wayne, for the fine magazine, and I hope to talk to you again next time you get to Albuquerque.

Gary Diamond K5FSB
Albuquerque NM

DON'T LET US DOWN

Where are the MARCH PROPAGATION CHARTS? I just received my April issue of *73 Magazine*, and no chart for March. Of course there was the April Propagation Chart, but this doesn't help for March.

I started taking *73 Magazine* when I found they had Propagation Charts. Thanks, for letting me bring this to your attention. Please don't let us down again.

Ivan S. Miller W5HFU
Oklahoma City OK

Sorry – it won't happen again. Due to a change (acceleration) of our production schedule, we were forced to miss a month of John Nelson's fearless (and unbelievably accurate) forecasts. – Ed.

ARE YOU SURE? (NO)

Re your article in the March '76 issue of *73 Magazine*, page 44.

Are you sure this article should have been published in the March issue? (Does it not belong in an April 1st issue?)

The diameter of the disc has no bearing on wind speed; it would give one count per revolution whether the disc was 1/8" or 1 yard in diameter. The rpm would only be determined by the length of the arms – the shape of the cups minus friction of the bearings.

A chip of mirror glued to the shaft to reflect the light from the LED to photo cell would work just as well.

Until reading this article I had thought *73 Magazine* was a serious ham-oriented magazine – not just for laughs. I believe this space should have been occupied by a more realistic theory.

Ulmer S. Anderson W7MHY
Hadlock WA

I published an article on a frequency synthesizer in the Sept. '75 and Oct. '75 issues of *73*, and I am sorry to say that I have only now discovered an error in it. The tuning diodes used in the oscillators should be type MV1404, not MV1401 as listed. The MV1401 diodes have too high a capacitance (nom. 550 pF as opposed to 120 pF for the MV1404), and if they are used the oscillators will only operate with control voltages above 6 volts.

I hope you will publish the above in your letters section; it will save anybody trying to build the synthesizer a great deal of frustration.

Noel Calvin
Berkeley CA

I just finished the April issue of *73* and must comment on the fine articles in this great issue.

Nat Wadsworth's article "Computers are Ridiculously Simple!" was very informative and nicely written; from what I learned it seems to me that Fig. 7, picturing binary number 10101010, should be decimal value 170, not 160 as stated.

No doubt you will have many other letters correcting this. Hi. Hi.

I also intend to give your staff more work on the Reader's Service page this month, as you request.

Keep up the good work on a fine magazine; can we see more articles on ATV and SSTV in upcoming issues?

Charlie McBride VE3GYT
Grimsby ONT

I made a mistake on my Touchtone Decoder article (April, 76) in regards to the parts availability from CONTACT. The price quoted was intended to be for the printed circuit board alone. Inasmuch as there is no way CONTACT can supply the relay and board for the price stated, checks are being returned with my regrets for the error. Incidentally, the wired and tested version is going for $29.95.

William J. Hosking W7JSW
Scottsdale AZ

I've noticed an error in the April 1976 issue of *73*, page 63. The article is entitled "Inexpensive HF-VHF Frequency Standard."

Please note the following correction to the schematic shown. *Pins 2, 3, 6, 7 on each of the 7490 decode dividers must be grounded.* Other than this all looks fine. Thanks.

Gene Hinkle WA5KPG
Austin TX

UPSET

I was extremely upset over the first four lines of an article in your February 76 issue by Larry Kahaner WB2NEL (see page 136). He said, "While in my neighbor's house one day explaining how I can phone patch her brother in Germany, etc." Third party traffic into Germany is verboten and it is fellows like that that are causing the problems that we now have concerning reciprocal operating privileges here. The German Oberpostdirektion is seriously considering withdrawing privileges for armed service personnel here, i.e., all DA calls. It seems that U.S. amateurs have the mistaken idea that an unlicensed person in the U.S. can talk to a licensed person here if they are physically at the U.S. licensed station.

This is not true and that is causing the problem. Licensed operators here can only talk to licensed operators there. I cannot talk to my mother, for example, even if she goes over to my sister's home. My sister is licensed and I can talk to her, but no one else. Also, there is a kicker – if my sister were a Novice, I would not be able to talk to her on YOUR station unless I talk on the U.S. Novice band (which I can do) and she answers me CW, *and* your station is complying with Novice rules with respect to power, crystal controlled, etc. I would not be able to talk to a Technician at all unless it was on 2m.

Hugh G. Vandegrift
APO New York

DOWN OUR THROATS?

Enjoyed seeing you at Vegas. I thought you might like to know that there is 220 activity now in Phoenix. Just a few on 223.5 simplex for now, but there is talk of a repeater or two in the near future. More about that later.

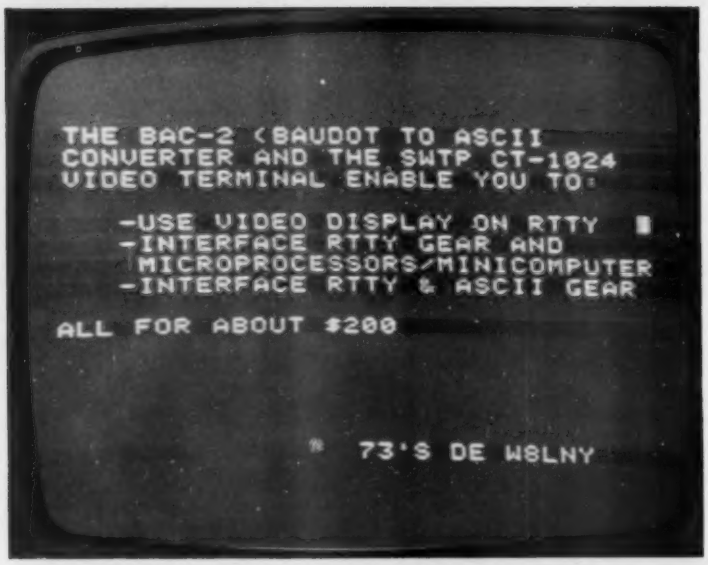
The Summer Hamfest sponsored by A.R.C.A. will be on July 30-31 and August 1, this summer, at Ft. Tuthill in Flagstaff AZ.

I like your new format in *73*, but I have one large gripe. Why are you shoving all this computer/microprocessor stuff down our throats? I buy *73* because I want to read about ham radio type activities, otherwise I would buy BYTE.

Bill Sargent WA7UJH
Phoenix AZ

Hi Bill, good to hear from you . . . re computers, the microcomputer is the most fantastic component for electronic systems yet invented . . . this means you will be using it in almost every piece of ham gear before long. Bill, you can remember the fuss when I started pushing FM and repeaters . . . older timers will remember the resistance I had to sideband and before that to RTTY . . . I'm used to fighting upstream on new ideas. Remember the terrible trouble I had getting hams

Continued on page 138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ASCII/Baudot with a PROM

-- for ribbonless RTTY or computers

Video displays are becoming increasingly popular in RTTY. In addition to eliminating the noise of mechanical printers (appreciated by the XYL), there is no mechanical maintenance or paper/ribbon changing. The video user has the ability to rapidly change baud rates for use in copying commercial stations and to use the video unit together with microprocessors.

Commercial kits start at $395 and up. This discourages many RTTY enthusiasts. Fortunately, Southwest Technical Products has a video display unit for $190.50 with power supply called the CT-1024[1]. It requires the user to accomplish his own Baudot to ASCII code conversion, which is the subject of this article. The result will be very close to the commercial units available with 3 exceptions:

1. *Page Size.*

HAL RVD-1005 – Has 40 characters/line, 25 lines for a total of 1,000 characters ($575); Leland – Also has 40 characters/line, 25 lines ($395 in kit form); CT-1024 – Has 32 characters/line, 16 lines for a total of 512 characters. Another 512 are stored for a 2 page memory.

2. *Scrolling.*

Both the Leland and HAL units scroll up the page. That is, each new line appears on the bottom and pushes the remaining lines up one. The SWTP CT-1024, on the other hand, wraps continuously around the screen. When it gets to the bottom, it starts over again at the top of the screen. The blinking cursor identifies the current position.

3. *Treatment of words at end of line.*

Both the HAL and Leland units start a new line somewhat prior to the actual end of the line on a space character, so as to not separate a word in the middle. This is not available on the CR-1024. It would be relatively easy to add with some counter ICs if needed.

Fig. 1. Overview – basic RTTY use only.

Basic Display Overview

Fig. 1 shows the functional flow of data from the RTTY terminal unit to the video display. At this point, you have the equivalent capability of the commercial displays previously discussed.

Fig. 2 shows three ways of getting from your present RTTY setup to the TTL logic level signals required by the BAC-2. Note that the output of the ST-5/ST-6 terminal units is the same as the RS-232C commercial data standard so that modem out-

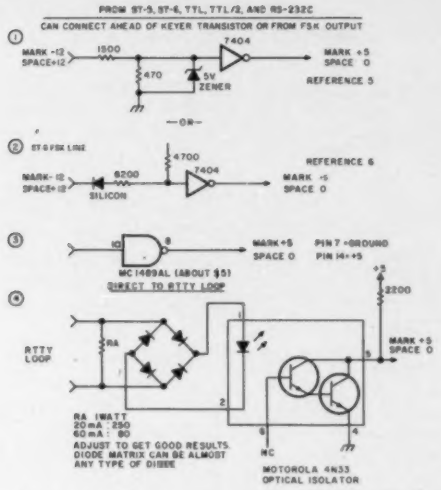


Fig. 2. Connection from RTTY loop to BAC-2.

puts could be treated the same way. Two of the circuits are described further in the references. The current loop interface can be used with any terminal unit and may be of interest to non-RTTY microprocessor users who want to use Baudot teletype equipment. The current loop interface is totally isolated from the loop.

Fig. 3A details the heart of the unit — the Baudot to ASCII converter — dubbed the BAC-2 (someone has probably designated a BAC-1!). The circuit provides:

1. Serial to parallel conversion of incoming Baudot signals using a UART and multiple speed clock for various baud rates.
2. Conversion to ASCII using standard 8223 PROMs (programmable read only memories).
3. Letters/figures case shifting from the 8223s to U4 wired as a cross coupled flip flop.

Fig. 4 details the connection of the BAC-2 basic unit to the SWTP CT-1024 terminal unit. Keyboard connections are specified — the user can also go in via the pins on the back of the unit. With parallel data, keep the lines between the BAC-2 and CT-1024 *extremely* short. Over 18 inches and ringing is likely to occur. The BAC-2 might be mounted right on the CT-1024 as shown in the picture.

Optional Circuits

Up to this point I have described using the BAC-2 primarily for RTTY copying. This will undoubtedly serve the needs of many readers. However, with microprocessors becoming more available and inexpensive every day, you might want to plan ahead now. I have a microprocessor using the Motorola 6800 CPU that provides all of the functions of RTTY Selcal, CW and RTTY ID, FIFO/UT-4 buffer storage, automatic transmitter control, ASCII-Baudot code conversion, and numerous other RTTY goodies. Use of a microprocessor is very easy and far less complex than wiring up a lot of discrete components for functions. Moreover, the functions can be changed much more quickly and easily by just changing the program.

If your future plans call for a microprocessor, you should plan now to get into serial mode rather than parallel mode for transferring data. Parallel mode has two disadvantages from my point of view:

1. Line lengths and interfacing techniques get tricky as you add devices and circuits. Serial start-stop, on the other hand, is very forgiving and insensitive to glitches on the leading and trailing edges of pulses.
2. It is a snap to switch electronically between several input and output devices in serial mode. With parallel data either data selectors (such as the 74157) or tri-state buffers are needed. Further, the timing sequences for strobe pulses to indicate a character ready get pretty tricky with tri-state devices. Timing chips and extra circuitry will quickly cost far more in dollars and time than a couple of UARTs.

Fig. 5 shows a functional overview using the BAC-2 in a RTTY system with serial data flows. All data is flowing in TTL logic format (Mark = +5 V, Space = 0 V). Other units you may have can be readily added by converting them from/to serial mode. While the NAND and inverter gates don't really belong in a functional diagram, they help show how the pieces are integrated. The only things needed to be added for complete versatility are some switches to select/control the serial data flows as needed for use with the microprocessor. They can be omitted at this point for display use only. Note that the 8th or parity bit is ignored in all ASCII circuits. The steps through Fig. 3A are the same as the basic unit discussed previously. In Fig. 3B a PISO (Parallel to Serial Output) circuit is shown. The NE555 timer should be set to 110 Hz for 110 baud or 300 Hz for 300 baud use. It is simple and reliable and is discussed in depth in the *TTL Cookbook*[2]. Note some deviations from the *TTL Cookbook* diagram — the circuit as shown in the book does not work. Probably some minor typos in printing of the book. The same circuit is shown again in the path from the ASCII keyboard (if used) to the serial data flow. Use of an optional circuit between the keyboard and PISO to do things like repeat key, counting characters, and so forth may be desirable and is discussed in a past issue of 73[3].

The BAC-2 and PISO Optional Circuit Board. A pack of cigarettes is included to show size and is not required for successful operation.

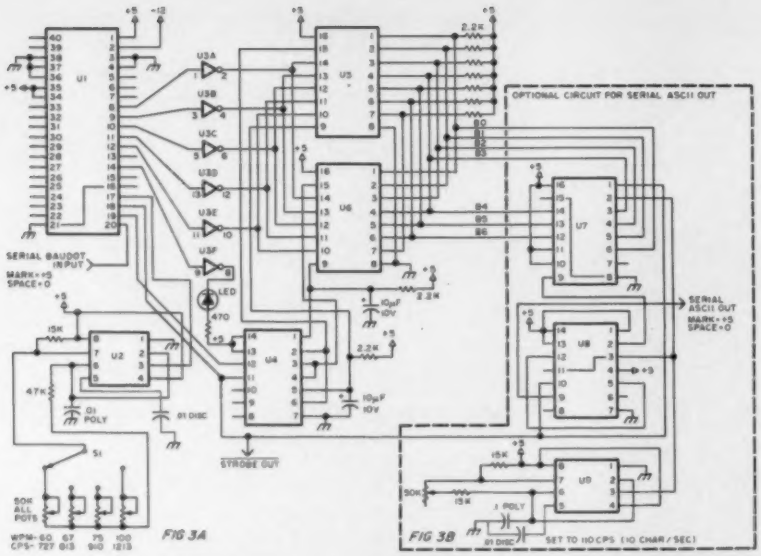


Fig. 3. Baudot to ASCII converter. U1: UART (see text). U2: NE555 timer. U3: 7404 6-inverter. U4: 7400 4-NAND. U5, U6: 8223 PROM. U7: 74165 PISO register. U8: 7474 flip flop. U9: NE555 timer. All resistors: ¼ W 20%. S1: single pole, 4 position rotary. LED: any LED.

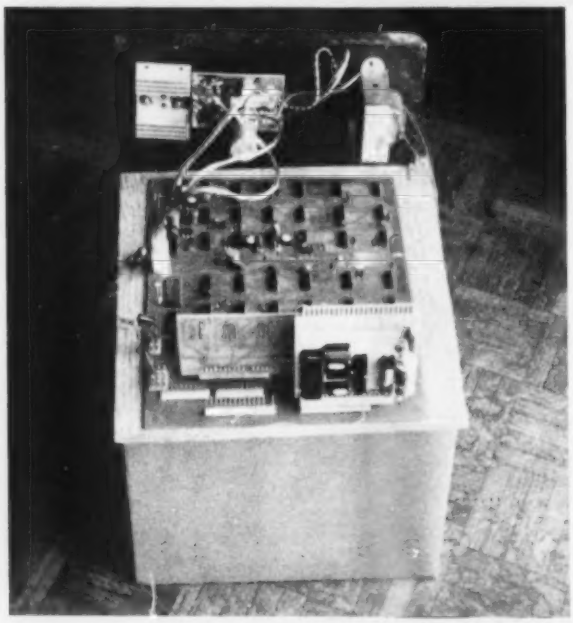
Use of two gates provides the mixing of ASCII signals from the keyboard, BAC-2, and/or microprocessor. If not using a micro at this time, simply leave the connections open and tie the ASCII from the microprocessor to +5 V for now.

Fig. 6 shows a serial to parallel (SIPO) converter to front end the CT-1024 terminal. Not much to hooking it up. SWTP also has a CT-S kit available for $39.95. It involves a lot of conversions from/to the commercial RS-232C standard, which is nice if you use it. The SIPO circuit can be built for less than $10 depending on where you get the UART.

We use Fig. 4 again to interface from the SIPO to the CT-1024 terminal. Same leads and terminology – just a different source.

Fig. 7 is optional and converts the serial data from TTL to the commercial RS-232 standard for use with an "outside world" terminal such as commercial computer video displays, printers, or 33 teletypes with RS-232 conversion built into the TTY.

At this point, you are probably wondering where the ASCII to Baudot circuit is. We have everything flowing everywhere but back to the teletype. The answer is there isn't any! The microprocessor provides the tool for the code conversion and the FIFO type buffering of data. If you don't plan on a micro, a circuit to convert from ASCII to Baudot can be constructed and was described in a recent *73* issue[4]. The micro also provides for CW/RTTY ID, "Here is" Key, and other goodies to the RTTY system.



The CT-1024 Terminal Unit mounted on a board with power supply in rear. A SIPO converter is standing upright on the back of the unit.

Construction of the BAC-2

The circuit was constructed using wire wrap methods. Not only is it inexpensive, relatively fun (you can overlap wrapping and watching TV at the same time with the family), but also totally flexible as far as experimenting and making changes. Requirements are a wire wrap tool[7], some wire (#30 Kynar – $10 for 1,000 feet usually, or available prestripped), a wire stripper (filing a notch in a pair of needle nose pliers with cutter is good), wire wrap sockets, and a board. Radio Shack has

BAC-2/SIPO	CT-1024 Connector J9
B0	1
B1	4
B2	5
B3	7
B4	8
B5	11
B6	12
$\overline{\text{STROBE}}$	10
+5	2
–12	6
GROUND	3

CT-1024 Connector J3

Jumper pin 3 to pin 7 to force erasing each line prior to data entry.

CT-1024 Wiring Option

Jumper 1 to 3 for negative going strobe.

Fig. 4. BAC-2 parallel interface to SWTP CT-1024 terminal.

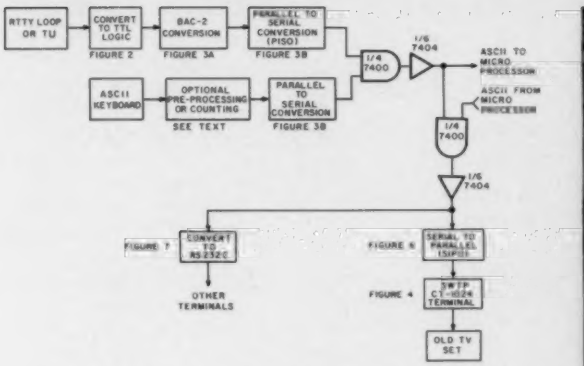
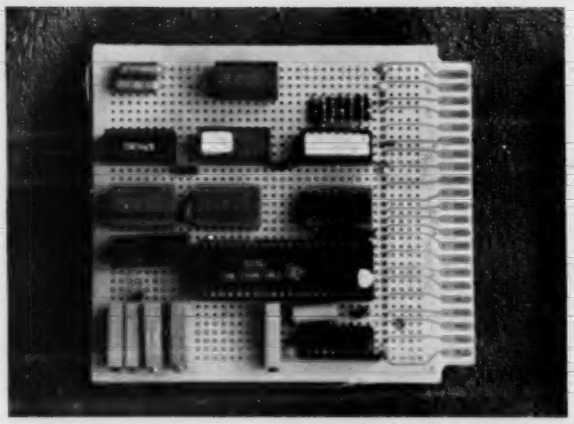


Fig. 5. Functional overview – serial option.



The BAC-2 converter board (subject of this article). The one chip on the side opposite the 5 trim pots is not part of the article circuit (corrects an error in programming my PROMs).

a new board (276-152) for $2.99 which provides space for IC sockets and a dual 22 pin edge connector. The mating connector (276-1551) is also $2.99. Watch out for some boards that have holes every .200 inches rather than .100 inches per the catalog specs. Somehow these crept into stock in a few stores and should be avoided. The board includes the PISO circuit of Fig. 3B. You may want to consider crystal control of the baud rates using circuits that have appeared from time to time in the *RTTY Journal* or *73 Magazine*, if a counter is not available. I have had no trouble with the NE555 timers. Of interest in Fig. 3A is an LED indicator connected to pin 14 of the UART. If it flashes, the incoming data has no valid stop bit. This is super for copying commercial stations with varying shifts, baud rates, and upright/upside down shifts. Just experiment with the controls until the bad stop LED goes out.

Readers who have built a UT-2/UT-4, or other equipment incorporating a UART, can skip U-1 and U-2 in the diagram and connect directly to the code conversion circuits in parallel form. Likewise, the UART can be used to up speed convert at no extra charge by wiring up the transmit side of the UART to convert all Baudot to, say 100 wpm.[6] The transmit side of the UART cannot be used for the serial ASCII output in Fig. 3B due to the limitation that it be used with either 5 or 8 bit code on both sides (you can't split it). When a valid character has been received by the UART, the data received line (pin 19) goes high. It is inverted and connected to the data received reset (pin 18) to reset the UART. The data is available prior to the data received line going high and stays so until the next character comes along allowing plenty of time for the 8223 PROMs to convert the code. The reset (pin 18) gives us a strobe line that is negative going to trigger the PISO circuit or the CT-1024 terminal depending on hookup.

The received data (pins 12-8) of the UART are buffered by 7404 hex inverters to protect the UART, provide the drive for more than one code converter chip, and allow use elsewhere.

Code conversion is accomplished by two 8223 PROMs. These are available from a variety of sources. A self-programming technique was described as a part of another circuit in 73.[8] The author of that article also mentions references for programming. Fig. 8 shows the bits to be programmed (blown to 1) on the 8223s. These are the Mark-Sense cards used by Hamilton-Avnet, a major wholesale distributor of ICs. Hamilton charges $8.95 each to provide an 82S23 (newer version of the 8223) already programmed ($6.45 + $2.50 programming) per the specs of Fig. 8 if you have prepared the card. The cards shown are for unshift on space – bit 7 is used to select the other chip when going from letters to figures. Terminology for the two chips is described in Fig. 8 for communication purposes together with the distinction between having unshift on space or not. If you want the option of switching between unshift on space or not, you might add another 8223 with a switch to the enable line (pin 15), or add some gates to select the

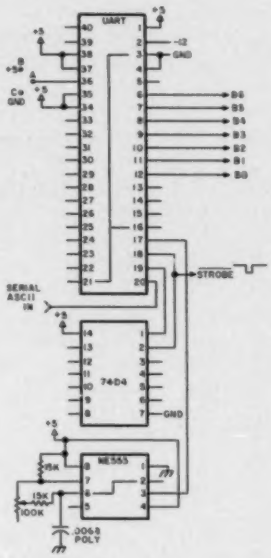


Fig. 6. Serial in/parallel out (SIPO) for ASCII code. Jumpers: A – B, 2 stop bits; A – C, 1 stop bit. Adjust for 16x baud rate: 110 baud = 1760 Hz; 300 baud = 4800 Hz.

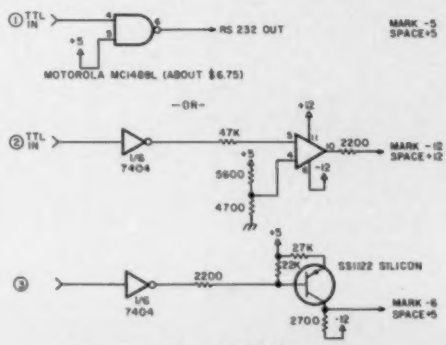
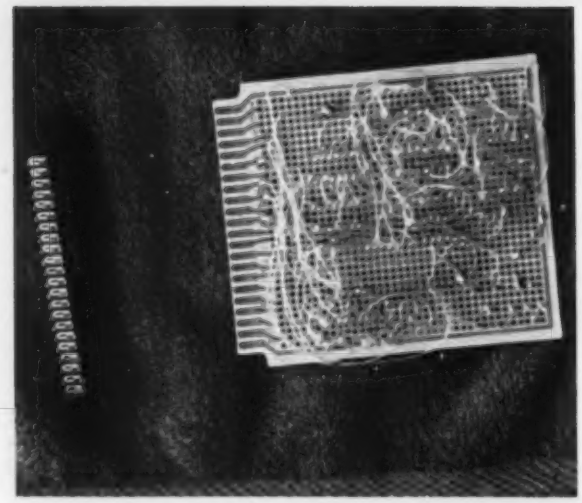


Fig. 7. TTL to RS232-C conversion.



Flip side of BAC-2 board. The wire for wire wrapping is a very pale yellow and doesn't show very well.

character yourself. Note that the Baudot control functions, Letters, Figs and Blank, are all translated to the ASCII Rubout (all 1s) character to be ignored by either your microprocessor or video display. The two 10 uF capacitors prevent the flip flop for letters/figures from triggering as the 8223s change state.

The CT-1024 Display Unit Construction

The SWTP display unit is available in kit form for $190.50.[1] Boards only are also available for $47.50. The ICs and discrete components can be purchased from *73* advertisers for $50-70 in total. Readers with a well-endowed junk box might want to go the board route to save money. Caution: The boards are very complex and built to excellent and exacting standards by SWTP. I would not recommend attempting to make them yourself or to purchase them from anyone other than SWTP. *Radio Electronics*[9] magazine carried a series of articles on the CT-1024 if you want to read more prior to making a decision (the TV Typewriter II in the series). I don't recommend the TV Typewriter I (Sept. 73 *RE*), as some additional interfacing is needed for it to properly handle the line feed, carriage return, no display of rubouts, scrolling, clear, etc. The TVT I is tough to use either with a micro or RTTY without extensive rework.

A feature not described by SWTP is to tie pin 3 to 7 of the cursor socket (J3). This causes the CT-1024 to clear the next line upon receipt of a CR/LF combination. Without this, it provides a very confusing display. It automatically starts a new line and clears it when the end of a prior line is reached (non-overline) when wired this way.

Assuming that you have built up the CT-1024 in one form or another, the next step is to interface it with a TV set. The CT-1024 instructions provide an interface to a Motorola TV. Lancaster[10] discusses interfacing video signals to TV sets in depth in a recent BYTE article, and will have this available in a "TV Typewriter Cookbook" shortly. You should be able to test the CT-1024 by grounding the data line that you want to be a zero and then grounding the strobe line to see that it is working. An ASCII keyboard could also be attached to check it out.

The SIPO (Serial In/Parallel Out) Circuit

The circuit in Fig. 6 can be readily constructed on perfboard or the same Radio Shack boards discussed previously. Set the NE555 timer

MARK SENSE PROGRAM CARD

WORD	NOTES	B7	B6	B5	B4	B3	B2	B1	B0
000	LTRS	■	■	■	■	■	■	■	■
001	K	■	■	□	□	■	□	□	■
002	Q	■	■	□	■	□	□	□	■
003	U	■	■	□	■	□	■	■	■
004	FIGS	□	■	■	■	■	■	■	■
005	J	■	■	□	□	■	□	■	■
006	W	■	■	□	■	□	■	■	■
007	A	■	■	□	□	□	□	□	■
008	X	■	■	□	■	■	□	□	□
009	F	■	■	□	□	□	■	■	□
010	Y	■	■	□	■	■	□	□	■
011	S	■	■	□	■	□	□	■	■
012	B	■	■	□	□	□	□	■	□
013	D	■	■	□	□	■	□	□	□
014	Z	■	■	□	□	■	■	□	□
015	E	■	■	□	□	□	□	■	■
016	V	■	■	□	■	□	□	■	□
017	C	■	■	□	□	□	■	□	■
018	P	■	■	□	□	■	□	□	■
019	I	■	■	□	□	□	■	■	■
020	G	■	■	□	□	□	□	■	■
021	R	■	■	□	■	□	□	□	■
022	L	■	■	□	□	□	□	□	■
023	LINE FEED	■	□	□	□	■	□	□	□
024	M	■	■	□	□	■	■	□	■
025	N	■	■	□	□	■	□	■	■
026	H	■	■	□	□	■	□	□	□
027	SPACE	■	□	■	□	□	□	□	■
028	O	■	■	□	□	■	■	■	■
029	CAR RET	■	□	□	□	■	□	■	■
030	T	■	■	□	□	■	□	□	■
031	BLANK	■	■	■	■	■	■	■	■

MARK ONLY BITS TO BE PROGRAMMED WITH SOFT LEAD PENCIL

OVER FOR FULL INSTRUCTIONS

MARK SENSE PROGRAM CARD

WORD	NOTES	B7	B6	B5	B4	B3	B2	B1	B0
000	LTRS	□	■	■	■	■	■	■	■
001	(	■	■	□	□	■	□	□	■
002	1	■	■	□	■	□	□	□	■
003	7	■	■	□	■	□	■	■	■
004	FIGS	■	■	■	■	■	■	■	■
005	.	■	■	□	□	■	□	■	■
006	2	■	■	□	■	□	■	■	■
007	–	■	□	■	□	□	□	□	■
008	/	■	■	□	□	□	□	□	■
009	1	■	■	□	□	□	■	■	□
010	6	■	■	□	■	■	□	□	■
011	*	■	■	□	■	□	□	■	■
012	7	■	■	□	□	□	□	■	□
013	8	■	■	□	□	■	□	□	□
014	"	■	■	□	□	■	■	□	□
015	3	■	■	□	□	□	□	■	■
016	;	■	■	□	■	□	□	■	□
017	:	■	■	□	□	□	■	□	■
018	9	■	■	□	□	■	□	□	■
019	8	■	■	□	□	□	■	■	■
020	&	■	■	□	□	□	□	■	■
021	4	■	■	□	■	□	□	□	■
022	)	■	■	□	□	□	□	□	■
023	LINE FEED	■	□	□	□	■	□	□	□
024	.	■	■	□	□	■	■	□	■
025	,	■	■	□	□	■	□	■	■
026	#	■	■	□	□	■	□	□	□
027	SPACE	□	□	■	□	□	□	□	■
028	9	■	□	■	□	■	■	■	■
029	CAR RET	■	□	□	□	■	□	■	■
030	5	■	■	□	□	■	□	□	■
031	BLANK	■	■	■	■	■	■	■	■

MARK ONLY BITS TO BE PROGRAMMED WITH SOFT LEAD PENCIL

OVER FOR FULL INSTRUCTIONS

*Fig. 8. 8223 read only memory coding. Bell prints as *. Blacken B7 (first box) to block unshift or space.*

rate to 16x the baud rate; i.e., for 110 baud/10 characters per second, 1760 Hz would apply. Jumper A to B for 2 stop bits (110 baud), and A to C (300 baud +) for 1 stop bit as necessary.

Conversion to RS-232C Standard Data Logic

Fig. 7 shows possible ways to convert from TTL to RS-232C logic. Either results in pretty much the same thing. The trade-off is what power you have available versus using discrete components.

UART Considerations

The UARTs specified in the various circuits are the "standard" variety. Makers and models are as follows:

1. Texas Instruments – TMS6011.
2. General Instrument – AY-5-1013 or AY-5-1014. The 1014 is nice in that no –12 V is needed – pin 2 is left unconnected.
3. Western Digital – TR1602B.

These are readily available from *73* advertisers and other sources.

Summary

I have discussed various ways of setting up the conversion from Baudot to ASCII and the video display. Hopefully, you will be able to select the options that you want. The Baudot to ASCII circuit (BAC-2) in and of itself may be useful for working with a microprocessor in that the program to convert back again can be readily loaded from 5 level paper tape using Baudot equipment. Once loaded, the conversion back can be done via the program. This enables SWTP M6800 microcomputer system users to use 5 level equipment and avoid going to ASCII equipment. I do not have a source for printed circuit boards – let *73* advertisers know if you need them and perhaps someone will make them up. ■

References

1. CT-1024 Terminal, Southwest Technical Products, Inc, 219 W. Rhapsody, San Antonio TX 78216. Prices for:

A. Complete Kit	
CT-1024 Terminal System Kit	$ 175.00
CT-P Power Supply Kit	15.50
	$ 190.50
B. Boards Only	
CT-1024 Board Set	$ 47.50
MP6800 Processor Connector Set (provides 50 pins and mating molex connectors)	2.50
	$ 50.00

2. *TTL Cookbook*, Don Lancaster, Howard W. Sams & Co., Inc., 1974, pp. 262-265.
3. "Using a Bargain Surplus Keyboard," Cole Ellsworth, *73 Magazine*, January, 1976, p. 212.
4. "ASCII to Baudot Converter," Cole Ellsworth, *73 Magazine*, February, 1976, p. 52.
5. "RTTY Autocall – the Digital Way," L. W. Sanders, *73 Magazine*, February, 1976, p. 76.
6. "The Mainline UT-4," Irvin M. Hoff, *RTTY Journal*, March, 1975, p. 4.
7. Hand Wire Wrap Tool, Cambion #601-2506. Less than $3 from distributors.
8. "The Computer QSO Machine," B. D. Lichtenwalner, *73 Magazine*, January, 1976, p. 80.
9. "TV Typewriter II," *Radio Electronics*, Ed Colle, February/March/April, 1975.
10. "Television Interface," Don Lancaster, BYTE Magazine, October, 1975, p. 20.

I/O EDITORIAL

from page 81

Of course it is always possible that pressure on Congress will get so great that the postal monopoly will be broken. Right now it is a federal crime to compete with the post office. The mail could be carried at a good profit by private industry, if it were permitted. Industry could get the postal system back on its feet if permitted by the bureaucracy and the postal unions, something that doesn't seem even remotely likely.

Last year the post office rang up an $825 million deficit and it is expected to be almost double that by the June 30th end of the current fiscal year.

Every time I pause to think about our having to send a piece of paper from New Hampshire to California in order to communicate a message it makes me angry. It is ridiculous in these times. Letters can be sent by facsimile, by teletype, or some computer code and sent via wire, satellite or microwave. Western Union screwed up . . . if they had been looking ahead they would have gotten aboard some really inexpensive message system. Ma Bell (you probably noticed the page 3 mention, in May, of the wind up of her suit against *73* . . . *73* admitted no fault) could have worked up a good system using Bell wires and communications systems.

The soon to arrive inexpensive small office and home computer surely will blow off the lid. I'm still talking with the salesmen for the large computer firms and they apparently are still completely unaware of the revolution that is brewing in small computer systems. They say, oh yes, the microcomputer will cut the cost of the CPU (central processing unit), but there is no way that the cost of the peripherals is going to come down substantially . . . and after all, the cost of the CPU is not very significant for most systems, so therefore the cost of computer systems will stay up there in the $50,000 plus range for a long, long time.

Baloney.

Please don't tell the ivory tower boys about what is happening . . . about what is coming. We don't need IBM in there . . . or DEC. Let them keep working on their $100,000 systems and selling them the way they are right now. This will make it possible for a whole new bunch of companies to grow into the new field rather than have the old ones just keep getting bigger and bigger.

Let's take a look at the peripherals. One thing we need a lot of with any system are the CRTs . . . call them video typewriters or television typewriters (TVTs) . . . these are the primary input/output devices we will be using. Today you can buy a real dumb TVT for maybe $1500. The more sophisticated ones run double to triple that. I envision a CRT with a keyboard and a lot of smarts selling for under $200. It will have a microcomputer chip in it and be able to do a lot . . . play games . . . let you type letters and edit them . . . store a lot of form letters . . . do bookkeeping . . . keep all sorts of files . . . and a whole lot of things we haven't thought of yet. It will need some sort of file cabinet memory storage . . . probably not invented yet.

There are some storage devices in the works. Right now it costs about $5000 for a floppy disk system . . . that should drop to about $1500 in a few weeks when Diablo's new dual $1000 floppy drive is released. Others are in the works for $600. Somewhat slower tape systems will be able to hold enormous amounts of data . . . and at prices which will make DEC salesmen shake their heads in disbelief.

Speaking of Bell . . . the phone company got itself into the Blue Box situation because some engineers ignored a lot of the savvy of other engineers who warned them that using the same lines for signaling and customers was a bum deal. In the long run it is costing Bell heavily for trying to use one pair for everything. A relatively few signaling lines could switch vast numbers of communications lines . . . and there would be no problem with customers sending signals to bollix the charge meters.

Funny thing about the series we published on the phone circuits . . . until Bell made a big deal about it no one seemed to pay any attention. Bell could hardly have gone more out of its way to make sure that the article was noticed . . . coast-to-coast publicity on the radio, television and in the press! They sure brought a load of inquiries on *73* for copies of the magazine or the articles . . . we probably could have sold several thousand copies of the material if we'd been interested in helping people to defeat the phone system . . . but we just turned down all the requests.

Now, after paying several thousand dollars in legal fees, I don't think I should have been quite as solicitous of Bell's interests. On the other hand, after reading the underground telephone newsletter, I am convinced that Bell is able to locate Blue Boxes fairly fast these days and the circuits, even if people discovered how to use them . . . which was not explained in the articles . . . you had to know that or read it elsewhere . . . they would have gotten into trouble.

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- **INPUT/OUTPUT** (serial and parallel) for communication with the **outside real-world devices** such as printers, teletypes, telephones, security devices, security monitoring, etc.

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PROGRAMMER: SPHERE SYSTEM 330: you are interested in programming for fun or profit. You receive full language, and complete hardware. No kidding around for you.

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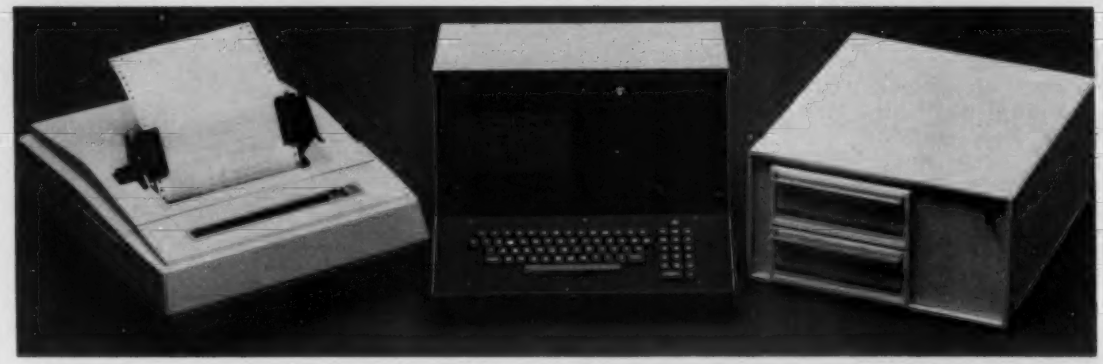

THIS IS THE SYSTEM 340 WITH PRINTER AND FLOPPY DISC

SYSTEM 310 (Formerly System 1)

- CPU/2 Module
- CRT Module
- KEYBOARD
- METAL BASE
- Low Profile Kit Cover
- ALL Hardware and cables included
- POWER SUPPLY
- PDS – Program Development System

SYSTEM 320 (Formerly System 2)

- CPU/2 Module
- CRT Module
- KEYBOARD
- SIM Module
- METAL BASE – attractive desk top metal chassis with card rack
- POWER SUPPLY

SYSTEM 330 (Formerly System 3)

- All of the above in System 320
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- BASIC Language on cassette tape

SYSTEM 340 (Formerly System 4)

- All of System 310 plus the following:
- PIM Module
- LINE PRINTER 80 column – 110 characters per second
- DUAL FLOPPY DISC MEMORY (256,256 bytes Memory on each disc)
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- Basic Language
- 16K Memory (Total 20K Memory)

NOTE: All assembled systems come with 9" video monitor installed.
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System 320K	$1190.00	System 340K	$6100.00

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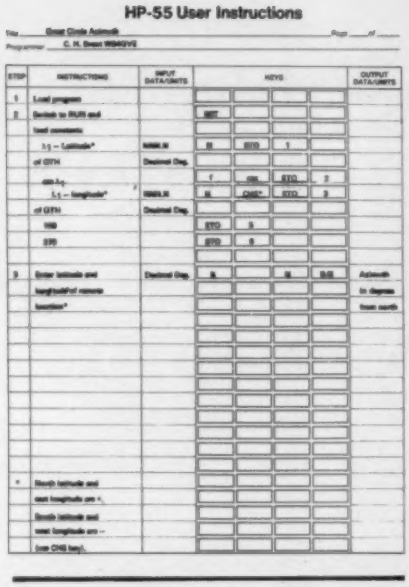

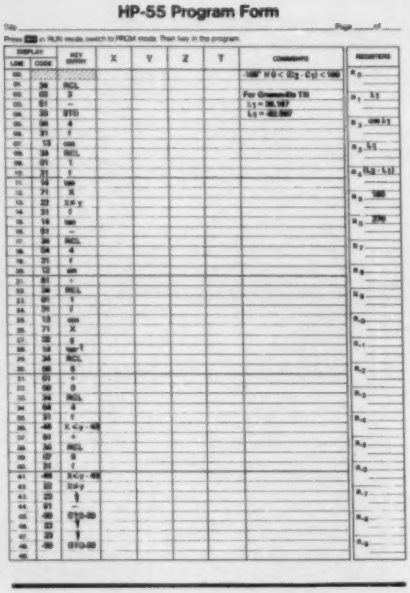

Aim Your Beam Right

-- with a programmable calculator

Chester H. Brent WB4GVE
149 Indian Hill Drive
Greeneville TN 37743

The recent arrival of programmable pocket calculators at more affordable prices offers the serious ham a new tool to improve his DX through proper antenna orientation. It also gives him a very good excuse for buying one of those very interesting new calculators that can be taught to perform in seconds what would otherwise be a rather messy calculation. After all, with the investment already made in a two gallon linear, hundred foot tower, and stacked yagis, it would be a shame not to get through the pileup because the antenna was pointed wrong. So will buying a programmable calculator fix this? It's not quite that easy, but even if you know nothing of computer programming and aren't too good in math, you can program this very useful computation.

Before proceeding further, some mention should be made of current practices among amateurs. All too often a ham utilizes great circle maps or azimuth information determined for a location considerably different from that of his QTH. This error, together with the tolerances encountered in orientation toward true north, mechanical drive backlash, and direction indication, can result in an appreciable loss of signal strength in the desired direction. The worst part is that the better the antenna, the less tolerant it is of error in direction.

The problem of finding true north, orienting the antenna, zeroing out the indicator and backlash error, and using maps and/or formulas for determining direction are all covered in various ham publications. Assuming proper attention to all the mechanical requirements yields acceptable accuracy, determination of the proper direction is the next concern. Great circle maps are good if your QTH happens to be near the map center. Otherwise, you are left with the pin, string, and globe approach. There are spherical trigonometry formulas one can use, but nobody in his right mind would recommend them. If one is reasonably careful in performing the calculations, a "correct" angle can be determined. Whether the angle is positive or negative, is referenced to north or south, or is the long or short path, is much in question. After much frustration, I set about to find a means of determining the azimuth from my QTH to any point on the earth without having to perform any calculations, map perusal, or thinking. Also, I had to find some good use for that HP-55 I had bought on impulse. (The XYL says the main difference between men and boys is the price of their toys.)

My math was too rusty to rely on, so I engaged a friend

City	Lat.	Long.	Azimuth
Bogota	4.5	-74.3	158.6
Calcutta	23.6	88.4	4.0
Canton	23.1	113.3	339.3
LaPaz	-16.5	-68.4	158.8
Perth	-32.0	115.9	290.3
New York	40.8	-74.0	91.5
Los Angeles	37.8	-122.4	272.9

Table 1. Practice examples (azimuth from Chicago: 41°52' N., 87°38' W.).

and math major to help develop a formula which not only could be programmed with a minimum of key strokes, but also permitted the calculator (not me) to determine the short path with a test and conditional branch. The basic formula is included in case you need to modify the instructions for a different instruction sequence (the algebraic vs. RPN system). For Hewlett-Packard and probably other RPN types, you can go right to the program.

clock for timing QSO IDs or can be used for metric and temperature conversions needed for foreign contacts. One precaution: Run the ac charger cord through grounded braid if there are large rf fields around. A further suggestion: Determine the azimuths to a few places in the manner you currently use, take this program to your friendly calculator dealer and have him check you out before you spend your money.

The basic formula is:

* * * * * * * *

$$\text{Azimuth} = 270 + \tan^{-1}\left[\cos\lambda_1 \; \frac{\tan\lambda_1 \cos(l_2 - l_1) - \tan\lambda_2}{\sin(l_2 - l_1)}\right]$$

* * * * * * * *

where

λ_1 = latitude of QTH
l_1 = longitude of QTH
λ_2 = latitude of distant station
l_2 = longitude of distant station

The procedure to follow is simple. The PRGM switch places the calculator in the learn position. The program is loaded into memory by keying in the strokes listed on the Program Form. The switch is placed in the run position, the BST button sets the program at the starting point, and you are nearly ready to start. There is some information that must be loaded into memory (because there wasn't room in the program for it and it can change for different QTH locations). This information is the QTH latitude, cosine of this latitude, QTH longitude, and two constants, 180 and 270. The formula was derived with *east* longitudes and *north* latitudes being positive numbers. The CHS (change sign) key must be used for *south* latitudes and *west* longitudes. Maybe that doesn't sound too simple, but it is only done one time. From then on the calculator displays the short path azimuth to any point if the latitude of the remote location is entered (ENTER), followed by the longitude, and the pressing of R/S.

The calculator can be left on in the shack and used to perform other calculations without affecting the stored program. The HP-55 has a

If the difference of longitudes $(l_2 - l_1)$ lies between zero and 180 degrees, then 180 must be subtracted to get the short path azimuth. Also, to avoid the denominator becoming zero (division by zero not allowed), some small amount can be added to the home QTH longitude (like 0.00001) when that constant is entered.

The following example happens to be the same as that in the ARRL *Antenna Handbook*. What is the azimuth from Chicago to Cairo? (Chicago: 41°52' N, 87°38' W) Converting to decimal degrees, key in 41.87 STO 1, f cos STO 2, 87.63 CHS STO 3, 180 STO 5, 270 STO 6.

To find the azimuth from Chicago to any place, key in the other place's latitude and longitude, available from an atlas, map, or world almanac. (Cairo: 30°00' N, 31°14' E) Key in 30 ENTER, 31.23 R/S, and read the answer displayed as 49.35° or 49° 20', the clockwise azimuth from true north. ■

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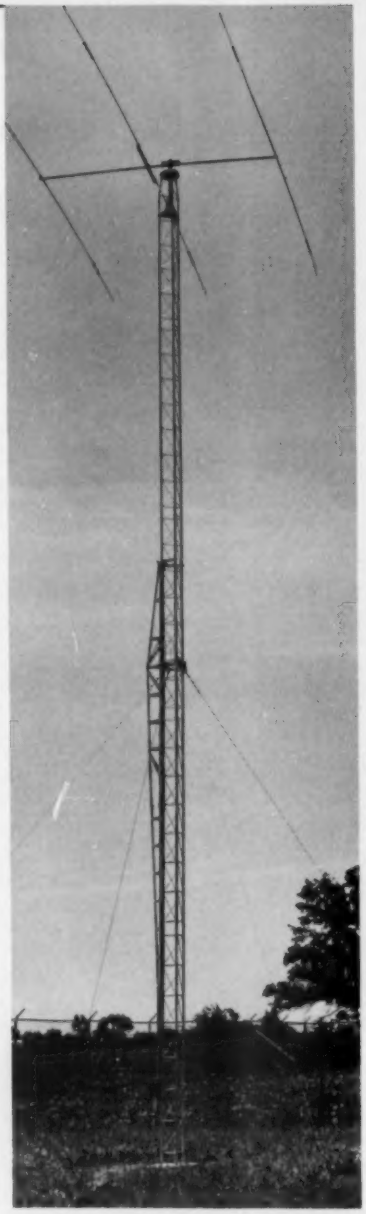

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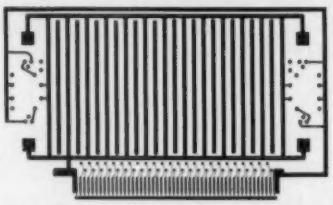

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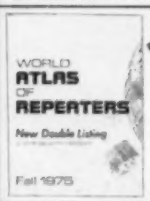

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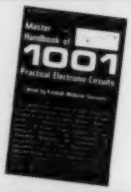

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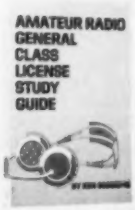

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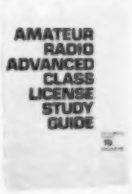

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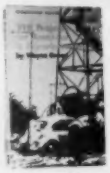

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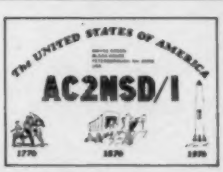

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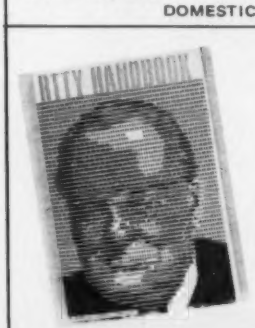

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CONTESTS

from page 15

2 meter bands, but repeater contacts are not allowed. Only one transmitter in operation at one time and no crossband contacts. Phone and CW are separate contests and must be scored as such.

FREQUENCIES:

Phone – 1850, 3950, 7235, 14330, 21385, 28525, 51000, and 2 mtr simplex. CW – 1810, 3535, 7035, 14035, 21035, 28035, 50050, and 144050. Novice – 3725, 7125, 21125, 28125. Please do not interfere with any nets or other traffic sessions!

EXCHANGE:

MINN stations send RS(T) and county; others send RS(T) and ARRL section or country.

SCORING:

Score 1 point per QSO, Novice QSOs count 3 points. MINN stations multiply points by number of sections and DX countries (NOT US or Canada). Others multiply QSO points by number of MINN counties (87 maximum). Any stations using 250 Watts or less multiply final score by 1.5. Special events call station will count 5 points per QSO.

ENTRIES:

Logs must include: date, time (GMT), band, mode, and contest exchange. Stations making 50 or more QSOs must include a check sheet for each band and mode. Usual disqualification criteria. Logs must be postmarked by July 2nd and received by July 9th to be eligible for awards. Mail entries to: HARC, c/o WB0MAO Steven J. Gardner, PO Box 261, Staples, MINN 56479. Please include your rig description and an SASE for results.

RSGB NATIONAL FIELD DAY

Starts: 1700 GMT
Saturday, June 12
Ends: 1700 GMT
Sunday, June 13

The only eligible entrants for this contest are G, GC, GD, GI, GM, and GW stations. However, overseas stations are welcome to submit check logs. A certificate will be awarded to the overseas station in each continent whose check log shows he has contributed the most points to competitors. All contacts must be on CW only using the 160 to 10 meter amateur bands. Each station may be worked once on each band but crossband contacts are not allowed.

EXCHANGE:

RST and QSO number.

ENTRIES:

Logs must show date and time in GMT, callsign of station worked, and exchange sent and received. Use separate logs for each band and only use one side on each sheet. A cover sheet must also be included showing contest name, date, claimed score, callsign, name, address, station details, and signed declaration (standard declaration). All entries should be addressed to: RSGB HF Contest Committee, c/o D. Thom G3NKS, 20 Bramble Close, Copthorne, Crawley, Sussex, ENGLAND, RH10 3QB. All entries must be postmarked no later than 15 days after the contest.

ARMED FORCES DAY BANDS

Station	Military Freq. (kHz)	Mode	Amateur Band
WAR	4001.5	CW	3.5 - 3.75
Washington	4020	LSB	3.775 - 4.0
D.C.	4030	RTTY	3.65 - 3.775
	6997.5	CW	7.0 - 7.15
	14405	CW	14.0 - 14.2
	20994	USB	21.25 - 21.45
NAM	3385	CW	3.5 - 3.75
Norfolk	4012.5	RTTY	3.65 - 3.775
VIRGINIA	4040	LSB	3.775 - 4.0
	6970	LSB	7.15 - 7.3
	7301	CW	7.0 - 7.05
	7380	RTTY	7.1 - 7.15
	7385	CW	7.05 - 7.15
	13827.5	RTTY	14.1 - 14.2
	14385	USB	14.2 - 14.35
	14400	CW	14.0 - 14.1
	148.410 MHz	FM	
	150.90		
NPG	4001.5	LSB	3.775 - 4.0
San Francisco	4005	CW	3.5 - 3.65
CALIF	4010	CW	3.65 - 3.75
	6989	CW	7.0 - 7.075
	7301.5	LSB	7.15 - 7.3
	7347.5	RTTY	7.0 - 7.1
	7365	CW	7.075 - 7.150
	13922.5	RTTY	14.0 - 14.15
	14356	USB	14.2 - 14.275
	14375	CW	14.0 - 14.1
	14389	USB	14.275 - 14.35
	20983	CW	21.0 - 21.2
	20998.5	USB	21.27 - 21.4
Mt. Vaca	49.995 MHz	AM/USB/CW	50.0 - 51.0
	143.995	AM/USB/CW	144.0 - 146.0
	222.0	AM/USB/CW	221.0 - 222.5
Mt. Diablo	148.41 MHz	AM/RTTY	145.0 - 146.0
	148.95	FM	146.0 - 148.0
AIR	4025	LSB	3.775 - 4.0
Washington	7305	LSB	7.15 - 7.3
D.C.	7315	CW	7.0 - 7.3
	13997.5	CW	14.0 - 14.2
	14397	USB	14.2 - 14.35

WEST VIRGINIA QSO PARTY

Starts: 0100 GMT Saturday,
June 12
Ends: 0059 GMT Monday,
June 14

All amateurs are invited to participate in the QSO Party sponsored by the West Virginia State Radio Council. There are no operating time limits during the contest period. The same station may be worked on different bands for additional points, but only once per band regardless of mode. West Virginia stations may work each other.

FREQUENCIES:

35 kHz up from the bottom edge of each CW band and 10 kHz inside the general portion of each phone band.

EXCHANGE:

QSO number; RS(T); and county (if WVA), state or country.

SCORING:

A power multiplier will be allowed as follows: 200 Watts or less dc input = 1.5; over 200 Watts dc input = 1.0. Out-of-state stations determine their score by multiplying the number of QSOs times the number of different West Virginia counties worked (55 max). This total is then multiplied by the power multiplier as defined above for the total score. West Virginia stations multiply the total number of QSOs by the sum of the different WVA counties, US states, and ARRL countries worked. This result is then multiplied by the power multiplier to determine the final score.

AWARDS:

To be eligible for an award, a station may have only one unassisted operator. Awards will be issued to the highest scoring WVA station, 1st runner up in WVA, 2nd runner up in WVA, highest scoring station in each state, and the highest scoring station in each country. Decisions of the Contest Committee of the West Virginia State Radio Council will be final.

LOGS/ENTRIES:

Logs must indicate date, time, QSO number, callsign, QSO number received, signal reports, and county, state or country of the station worked. Indicate the mode and band also. Logs should be sent to: West Virginia QSO Party, P.O. Box 299, Dunbar, West Virginia 25064. Logs should be received no later than July 17th, and no logs will be returned.

ARRL VHF QSO PARTY

Starts: 1900 GMT Saturday,
June 12
Ends: 0600 GMT Monday,
June 14

Check the May issue of QST for any last minute changes!

Entrants may operate no more than 28 of the 35 hours during the contest period. The seven hours off-time must be taken in increments of 30 minutes or more. Listening time counts as operating time. All contacts must be made on amateur bands above 50 MHz using authorized modes. Fixed, portable, or mobile operation under one call, from one location only, is permitted. Any transmitter used to contact a station may not be later used to contact another station during the contest period with any other callsign. Contacts made by retransmitting either or both stations (such as repeaters) do not count for contest purposes. Each contact exchange must be acknowledged by both operators before either may claim contact points. A one-way confirmed contact does not count.

EXCHANGE:

Exchange simply ARRL section.

SCORING:

On 50 or 144 MHz count 1 point per contact; on 220 or 420 MHz count 2 points per contact; on higher UHF bands, count 3 points per contact. Final score is then the total QSO points multiplied by the number of different bands for additional credits but crossband contacts are not allowed. Also, aircraft mobile stations cannot be counted for section multipliers.

ENTRIES:

All logs must be postmarked no later than July 7th and sent to: ARRL, 225 Main Street, Newington CT 06111. Logs and entry forms are available through this same address; please include an SASE. Usual awards will be issued and the standard disqualification rules will apply.

ARRL FIELD DAY

Starts: 1800 GMT, Saturday,
June 26
Ends: 2100 GMT Sunday,
June 27

Rules are generally lengthy (2 pages in *QST*); please refer to the May issue of *QST* for detailed information and for any changes since last year's rules.

Briefly, the general rules are as follows:

The contest is open to all amateurs within the ARRL sections; foreign stations may be contacted for credit but are not eligible to compete. Each entry will be classified by type of operation: Class A — Club group set up specifically for Field Day operation operating portable without commercial power; Class B — Non-club stations set up portable without commercial power; Class C — Mobile stations; Class D — Fixed stations using commercial power; Class E — Fixed stations using emergency power for transmitters and receivers.

All entries will further be classified by the number of transmitters utilized. Class A and B stations not beginning to set up before 1800 GMT on Saturday may operate the entire contest period. All others may not operate more than 24 hours total. Each station may be worked once on each band; voice and CW are considered different bands (all voice contacts are equivalent and RTTY = CW).

Class A, B, and C stations may contact anyone, but classes D and E must contact only Class A, B, or C.

EXCHANGE:

RS(T) and ARRL section or country.

SCORING:

Phone contacts count 1 point each and CW contacts count 2 points each. Final score is sum of QSO points times multiplier for highest power used at any time during the contest period, plus bonus points.

Power multipliers: Multiply by 5 if 10 Watts or less dc input power and non-commercial main power source or motor driven generator; multiply by 2 if less than 200 Watts; multiply by 1 if over 200 Watts up to 1 kW; multiply by Ø if over 1 kW (note — dc power on SSB is half PEP power).

Bonuses: (only for Class A or B stations) 100 points for 100% emergency power; 100 points for "natural" powered contact (only one QSO req'd); 50 points for public relations; 50 points for message origination for SCM or SEC; 5 points for each message received and relayed during FD period up to a maximum of 50 points; 50 points for completing at least one QSO on CW via OSCAR.

ENTRIES:

Standard disqualification rules apply. All entries should be sent to: ARRL, 225 Main Street, Newington CT 06111. Official log and entry forms are available from the same address for an SASE.

NOTE: ARRL policy is not to release information on ARRL contests until publication in QST. *Since this is too late for publication in* 73 Magazine, *I will continue to list rules on all ARRL contests based on the previous year's contest rules with reference to the appropriate issue of* QST *to check for any changes or updates. All other contest information will be the latest available at press time. — Bob WA1SCX*

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing °W
16584	1	0058:54	70.2	A	7058	1	0141:43	75.2
16597	2	0153:50	83.9	BX	7070	2	0041:03	60.1
16609	3	0053:46	68.9	A	7083	3	0135:20	73.6
16622	4	0148:42	82.7	B	7095	4	0034:40	58.5
16634	5	0048:38	67.7	A	7108	5	0128:57	72.0
16647	6	0143:33	81.4	B	7120	6	0028:18	56.9
16659	7	0043:29	66.4	A	7133	7	0122:35	70.4
16672	8	0138:25	80.2	B	7145	8	0021:55	55.3
16684	9	0038:21	65.2	AX	7158	9	0116:12	68.8
16697	10	0133:17	78.9	B	7170	10	0015:32	53.7
16709	11	0033:13	63.9	A	7183	11	0109:49	67.3
16722	12	0128:08	77.7	B	7195	12	0009:09	52.1
16734	13	0028:04	62.7	A	7208	13	0103:26	65.7
16747	14	0123:00	76.4	B	7220	14	0002:47	50.5
16759	15	0022:56	61.4	A	7233	15	0057:04	64.1
16772	16	0117:52	75.1	BX	7246	16	0151:21	77.6
16784	17	0017:48	60.1	A	7258	17	0050:41	62.5
16797	18	0112:43	73.9	B	7271	18	0144:58	76.0
16809	19	0012:39	58.9	A	7283	19	0044:18	60.9
16822	20	0107:35	72.6	B	7296	20	0138:35	74.4
16834	21	0007:31	57.6	A	7308	21	0037:55	59.3
16847	22	0102:27	71.4	B	7321	22	0132:12	72.9
16859	23	0002:23	56.4	AX	7333	23	0031:33	57.7
16872	24	0057:19	70.1	B	7346	24	0125:50	71.3
16885	25	0152:14	83.9	A	7358	25	0025:10	56.1
16897	26	0052:10	68.9	B	7371	26	0119:27	69.7
16910	27	0147:06	82.6	A	7383	27	0018:47	54.5
16922	28	0047.02	67.6	B	7396	28	0113:04	68.1
16935	29	0141:58	81.4	A	7408	29	0012:24	52.9
16947	30	0041:54	66.4	BX	7421	30	0106:41	66.5

HAM HELP

I will be glad to help with any phase of amateur licensing. We hold continuing education classes for ham licensing whenever demand warrants. Interested parties are invited to visit the school's club station, or feel free to call.

Richard Bley WB4GVA
Catawba Valley Technical Inst.
Hickory NC 28601
(704) 327-9124

I would be very happy to be of assistance to any prospective ham in this area who is in need of help.

David A. Deem WA3ZXI
8 Hawthorne Lane
Rosemont PA 19010
(215) 525-2684

Please add my name to your ham help list. I would also like to know if you know of any clubs in this area.

J. Bryan Loofbourrow
PO Box 1237
Mountainside NJ 07092

Wanted: adjustment/installation instructions for Hy-Gain TH-2 3-band 2 element beam antenna. Believe this antenna was built about 15 years ago — it uses blue phenolic traps similar to "slim line" traps in 12AVS vertical.

William W. Muessig K4FD
3156 Graham Road
Falls Church VA 22042

I would appreciate a manual or a copy of the schematic diagram of a Model 103B Hewlett-Packard oscilloscope. I will be glad to pay for copies and postage.

Claude Blakeslee WB6GHZ
C/O Mills High School
400 Murchison Drive
Millbrae CA 94030

Help!

Leonard J. Vanella
172 Irving Ave.
Floral Park NY 11001

I'll be glad to help newcomers.

Ross N. Dunnihou WN5MZZ
516 S. Cedar Box 134
Shattuck OK 73858

I need help!

William Cranford
1096 Atlanta Rd. Lot D-39
Marietta GA 30060
(404) 424-1473

Tracking the HAMBURGLAR

SWIPED: SBE — Linear Systems #SB 36, professional type amateur radio transceiver with #SB 36-ACP speaker and power supply. S/n 71128, base station, brushed chrome face, black cabinets. Courier #COP 50 HL, VHF monitor radio, hi and lo band. Brushed chrome face and knobs, black body. Courier #COP 75, VHF automatic scanner, hi band. Brushed chrome face, black body. These items were taken January 26, 1976 from South Fork Electronics Corp., 36 Hampton Road, Southampton NY.

SHANGHAIED: HW-202 transceiver s/n 09512. Has following crystals installed: 07-67, 34/94. Had WBØQGF engraved on outside and inside. Joel Humpke WBØQGF, 516 Zion St., Aurora CO. Taken March 1, 1976 from parking lot of radio station KLMN.

ROBBED: Standard 826M s/n 010230, Cobra 200 s/n 30900140 (220 MHz rig). Both modified with type N rf out connectors. Contact WA2CSE, 516-546-2571.

STOLEN: Clegg FM-27B s/n 27043-1649 taken in Huntington, New York on February 21, 1976. Also Touchtone pad and tone burst generator in minibox. Report to Suffolk County Police 2nd Precinct or call Dave Metal W2FTH, home 864-1130, or business 368-2200.

ABDUCTED: Clegg FM-DX, 2/19/76; Boston, Mass. Slide bracket riveted to top, s/n -056-, Police ID #141449314PTH. WB2ZSD — Call 201-263-0376, anytime.

FILCHED: Realistic pocket scanner has SSN 095-42-1177 engraved on set. Stolen February 29, 1976 at PPRAA Swapfest, Peterson Field CO. Please notify police dept. or James R. Einolf, 12149 N. Piney Ln. Rd., Parker CO 80134, 303-841-2105.

LOOTED: Icom 230 s/n 2403831 taken from my car on 2/21/76 in Bellows Falls, Vermont. Anyone using it after that date will self destruct! Tom Abare K1VNE, 22 Lockwood Street, Bellows Falls, Vermont 05101.

TUNE IN THE SPIRIT OF 76

ARRL NATIONAL CONVENTION

DENVER, JULY 16, 17 & 18

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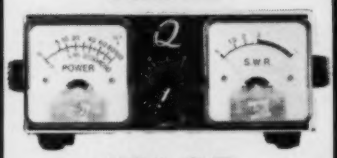

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Looking West

from page 25

your problem and offer simple concrete suggestions towards finding a quick solution. Most of all, he is dedicated to uniting the diverse factions and geographic areas administered by SCRA and thereby to building SCRA into an organization that will serve the needs of all members as well as those who are now non-members operating unsanctioned, uncoordinated systems. His goal seems to be one of "promoting coordination through promoting friendship."

He has already taken some affirmative steps in that direction including dividing the existing technical committee, heart of SCRA, into two sub-committees. Staffed by the best expertise he could muster, those involved with the development of two meters administer the affairs of two meters, and in a like manner, those involved in 220 MHz are determining the future of that band. The best experts of each are working toward a bright future for each.

"Why do this?" you may ask. Simply, who knows more about 220 MHz than those pioneering it at this time? If growth and development of that band are to avoid all the pitfalls and headaches that befell the growth of 2 meters, then it must have the proper guidance. Fred Deeg K6AEH of WR6AFM is head of the 220 task force sub-committee that will oversee this development.

At present, Bob himself is heading up the two meter sub-committee (I told you he was the kind of person that indeed does get involved), and has gotten hold of some of the finest talent in the two-way communication industry, who also happen to be amateurs concerned with the positive growth of VHF, to serve on this committee. I have already noted the part that Jim Hendershot will play, and in addition to Jim, you will find such people as Ray Vonnuman K6PUW, Neal McKie WA6KLA, and a myriad of others selected for their technical ability and overall knowledge of the problems of the geographic areas they represent.

The basic purpose and intent of SCRA has not changed. It is still the same organization that started four years ago to iron out the mess that was two meters in Southern California before its arrival. People like Dick Flanagan, Skip Clark, and Bill Carpenter have taken it from its very infancy to where it is now. In the process, much was accomplished, and at the same time many mistakes were made. From these mistakes, though, has come possibly the most viable of all coordinating organizations to be found anywhere in the nation, one that I personally feel proud to support. SCRA learned from its mistakes, was never too proud to admit that they were made, and has used this accumulated knowledge to benefit the entire Southern California FM community. Now with a broad based new directorship, this organization is again out to conquer new horizons and faces the future hoping to bring more constructive coordination to the Southland. All they ask is the continued support of those who have worked to build the organization, and more important, the support of those who intend to work toward future development of two and 220. Maybe the term "pirate repeater" will soon be a thing of the past here in the Southland. It's a good goal to work towards.

This then brings us to another important topic, but also brings a problem for yours truly. It involves a coordinated repeater facing interference from the users of an uncoordinated system that took up operation on the same channel pair. "Why then," you may ask, "should this cause old 'ITF' a problem?" Well, you see, I happen to be involved with one of the two systems in the controversy (the coordinated one, thankfully) and am therefore torn between my outlook as a repeater user and maintaining my credibility in this column.

Therefore, I hope that the following is a solution to my dilemma, and one that meets with your approval. Rather than personally commenting on the matter, I am writing to the licensees of WR6ABB – PARC, Los Angeles (coordinated), and WR6AFR – Juniper Hills (unsanctioned). I will publish the response of both *unedited*. I will also publish the final report of the SCRA technical committee and thereby permit you to make your own judgments and find your own conclusions.

As a member of the board of directors of the Palisades Amateur Radio Club, owners of WR6ABB, and a control station for that system, my personal views on the matter must remain mine, and I hope that the method I have chosen to report on this meets with your approval and more important, that it thereby permits me to retain my credibility in your eyes. Believe me, it is a very tough position to find oneself in and I hope you never face the same problem.

As usual, we have run out of space before running out of topics. No, we didn't forget our Guatemala wrap-up, the complete AJP story, the latest in public relations, and a myriad of other things. At least you know we will have some goodies for you next month. See you then.

NOTE: The Pottstown Area Repeater Team Hamfest and Flea Market, to have been held on May 23 as listed on page 128 of our May issue, has been canceled.

DULUTH MN
MAY 8

The Twin Ports FM Club swapfest will be held May 8 from 11 am to 3 pm at the First Methodist Church, 6th Ave East and Mesaba Ave, Duluth MN. Talk-in 34/94. Advance registration $1, at the door $1.25, booth space $.75. Write WAØBJY for more information.

SEABROOK NH
MAY 8

The Hosstraders Third Annual Tailgate Swapfest will be held Saturday, May 8, at 11 am at Addams' Campground, Route 286, Seabrook NH off Route 95 at the Mass-NH border. Admission 75¢, dealers included, no commissions or percentages. Excess revenues benefit March of Dimes birth defects campaign. FM clinic sponsored by Saddleback Repeater Association. Talk-in .52, .40-00, and/or 3940 kHz. If any questions, SASE to WA1IVB, Box 32, Cornish, Maine 04020.

GREEN BAY WI
MAY 8

The Green Bay Mike and Key Club's Electronic Hobby Swap will be held on Saturday, May 8, 1976 from 0800 to 1600 at the Army National Guard Building, 800 N. Military Av., Green Bay WI. Talk-in on 146.94. One dollar at the door. Located on Business 41. Easy to find.

COLUMBUS GA
MAY 8-9

The Columbus Amateur Radio Club (Georgia) is holding its annual Hamfest on Saturday and Sunday, May 8 and 9th. The hamfest will be at the Fine Arts Building, Columbus Municipal Fairgrounds, Columbus, Georgia. For further information contact Dennis Hand, Jr. K4ICR, Route 1, Box 172A, Cataula GA 31804.

FORT WALTON BEACH FL
MAY 9

The Playground Amateur Radio Club will hold its Sixth Annual Swapfest Sunday, May 9, 1976, from 8 am until 4 pm at the Fort Walton Beach Fairgrounds. Registration $1.50 advance – $2 at door. Free swap tables. For hotel and other information write: Swapfest Committee, PO Box 873, Fort Walton Beach FL 32548.

SOUTH CAROLINA BICENTENNIAL AMATEUR RADIO WEEK
MAY 10-16

South Carolina State Governor James B. Edwards, has issued a proclamation declaring May 10th through May 16th, 1976 as Bicentennial Amateur Radio Week for South Carolina. He encourages all amateur radio clubs in the state to take part in this activity. The Holiday VHF Society of Charleston will be operating a special events station "AA4SC" during the 14th, 15th, and 16th of May from the Governor's Mansion in Columbia, South Carolina. This special station will operate CW/SSB on 10 through 80 meters, FM on 2 meters, and 2 meter-10 meter Oscar satellite communications. A special commemorative certificate will be made available to stations making contact with AA4SC.

WEST LIBERTY OH
MAY 16

The Champaign Logan Amateur Radio Club is holding its 6th Annual Flea Market and Auction on May 16, 1976 starting at 12 pm at the West Liberty Lions Park at West Liberty, Ohio. Free admission, trunk sales and tables $1.00, door prizes. Talk-in on 146.52 and 146.13/73.

JAFFREY NH
MAY 15

The 1st Annual Fly In and Flea Market will be held Saturday, May 15, 1976 at the Jaffrey Municipal Airport (Silver Ranch) in Jaffrey, New Hampshire. *73 Magazine* will host the event. Picnic facilities, food stand, great ice cream, horseback riding available at Silver Ranch stables across the road from the airport (200 yds). Plenty of hangar space for exhibitors, etc. Come one – come all – if you can't fly – drive – but get here. Jaffrey is 6 miles south of Peterborough on U.S. Rte. 202.

EVANSVILLE IN
MAY 16

The Annual Evansville Hamfest will be held Sunday, May 16th, 1976 at the Vanderburgh Co. 4H Center (8 miles north of Evansville on Highway 41). Large indoor flea market area, displays, grand prize (HR2MS), door prizes, and auction sponsored by the Tri-State Amateur Radio Society. Lunch will be available and admission is free. Talk-in on 147.75/.15 and 146.52/.52. For more info and grand prize tickets contact: Tom Dick WA9QDZ, 2851 Wayside Drive, Evansville IN 47711, (812) 476-2188 or Randy Riggs WB9RDS, 1552 Keck Ave., Evansville IN 47711, (812) 464-3111.

ROCHESTER NY
MAY 21-23

The 43rd Annual Rochester Hamfest, now combined with the New York State ARRL Convention, will be held the weekend of May 21-23, at the Monroe County Fairgrounds, near Rochester NY. Registration in advance (by May 15) is $3.50; at gate $4. Banquet tickets are $8.50. Unlimited outdoor flea market space is available at $1 per parking space. Indoor flea market space, available by

SOCIAL EVENTS

advance order only, is $5 per table. Ticket orders and information requests should go to: Rochester Hamfest, Box 1388, Rochester NY 14603.

LAKE DELTON WI
MAY 22

The Yellow Thunder Amateur Radio Club will sponsor their 6th annual hamfest on Saturday, May 22, 1976 at the Dell View Hotel in Lake Delton, Wisconsin, starting at 10 am. Meetings and events include: swap shop, DX, VHF, RTTY, MARS, ARPSC, hidden transmitter hunt, ladies activities, liars contest and an evening banquet with entertainment including something new: "The Kitchen Maids." Grand prize: Regency HR2-B. Admission $7 in advance or $7.50 at the door. ($1.50 or $2.00 without the banquet.) For further information contact Kenneth A. Ebneter K9GSC, 822 Wauona Trail, Portage WI 53901.

PORTLAND ME
MAY 22

The Portland Amateur Wireless Association will hold an auction and dinner at the Portland, Maine, Ramada Inn, 1230 Congress Street (just off I295 Exit 5) on Saturday, May 22. Auction will start at 10 am. Dinner will start at 6:30 pm. For more information contact Martin Feeney K1OYB, 38 Howard Street, Portland ME 04101. Phone (207) 775-2274.

SANDUSKY OH
MAY 23

The Vacationland Hamfest will be held on Sunday, May 23, 1976 at the Erie County Fairgrounds from daybreak till 3 pm. Featuring — free camping Saturday night, free transportation to Cedar Point ferry boat dock. Bring the family and let them visit the greatest amusement park in the U.S.A. Plenty of flea market tables, dealers welcome, 8 acres for trunk sales. 1st grand prize: 1200 Watt ac gasoline generator. Tickets are $1.50 in advance — $2 at gate. Flea market vehicles $1 each. For further information or reservations write: E.A.R.S., PO Box 2037, Sandusky, Ohio 44870. Call in on 52-52.

WILMINGTON DE
MAY 23

The Eastern Shore of Maryland Hamfest (second annual), sponsored by the Easton Amateur Radio Society, will be held on May 23, 1976 rain or shine from 10 am to 4 pm. This will be the only hamfest this year on the eastern shore of Maryland or Delaware, south of Wilmington. Located 5 miles north of Easton, Maryland on Rt. #50 at the Talbot Co. Agriculture Center. From Balto-Wash. go across the Chesapeake Bay Bridge and stay on Rt. 50 for approximately ½ hour after crossing the bridge. There will be hamfest signs and talk-in on 52 and 94 simplex and on 146.445-147.045 repeater (Cambridge). Plenty of tables and chairs provided and reasonably priced food and drinks and lots of room and tables for tailgaters. $2 admission and $2 tailgate. For info contact: Tim Meekins K3RUQ, PO Box 805, Cambridge MD 21613 (301) 228-8534.

WABASH IN
MAY 23

The Wabash County Amateur Radio Club will hold their 8th Annual Hamfest Sunday, May 23, 1976 at the 4-H Fairgrounds in Wabash, Indiana. The hamfest will be held rain or shine. There will be a large flea market (no table or set-up charge), technical forums, bingo for the XYLs, free overnight camping with ac hookup, and plenty of parking. Lots of good food at reasonable prices. Admission is $1.50 for advance tickets, $2 at gate. For more information or advanced tickets write to Bob Mitting, 663 North Spring Street, Wabash, Indiana 46992.

KNOXVILLE TN
MAY 29-30

The Radio Amateur Club of Knoxville will hold its annual Greater Knoxville Hamfest on May 29 and 30th at the National Guard Armory, 3330 Sutherland Ave., N.W. Activities will include an indoor and outdoor flea market. Door admission $1 and a chance for a door prize. Tables and space rental for indoor flea market will be $2.50 per table. There will be a banquet on the 29th at 8 pm at Howard Johnson's, West Town at $6 per person. Talk-in on 16/76 — 34/94 and 3980. More information by SASE from Edward L. Melton WB4JGF, 749 Elkmont Rd., Concord TN 37922.

BURLINGTON KY
MAY 30

The Kentucky Ham-O-Rama will be held Sunday, May 30, 1976 (Memorial Day weekend) at Boone County Fairgrounds, Burlington, Kentucky. Ten minutes south of Cincinnati, Ohio near I-75. Prizes, forums, XYL program, exhibits and flea market. Tickets $1.50 advance. For more information contact: NKARC, PO Box 31, Fort Mitchell, Kentucky 41017.

TRENTON TN
MAY 30

The Humboldt ARC Hamfest will be held Sunday, May 30 at Shady Acres City Park in Trenton TN. Flea market, ladies activities, playground. Contact Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt TN 38343.

VINTON VA
MAY 30

The Roanoke Valley Amateur Radio Club is sponsoring their Annual Hamfest to be held at the Vinton War Memorial, Vinton VA on Sunday, May 30, 1976. Registration will be from 7 am until 9 am and the Hamfest and Flea Market will be from 9 am to 3 pm. Registration fee: $1.50 ea., 4/$5. Talk-in frequencies on 2 meters will be 34/94, 28/88, 38/98, and 94 direct.

FLUSHING NY
JUNE 5

The Third Annual Hall of Science Radio Club auction and flea market will be held Saturday, June 5 at World's Fairgrounds, Flushing, L.I. Admission $1.00, sellers $2.00. No sellers commission but 10% fee on auctioned items. Zoo, boating, children's farm, art and science museums adjacent. Field Day goodies galore. For more information write: Box 1032, Flushing NY 11352.

WINFIELD PA
JUNE 6

The Penn-Central Bicentennial Hamfest will be held Sunday, June 6 at the Union Township Volunteer Firegrounds, Winfield PA, 11 miles south of I-80 on Route 15. Contests, auction, flea market — start at noon. Registration $2; XYL, children free, free parking. Contact W3GPR.

HUNTINGTON WV
JUNE 6

The Tri-State Amateur Radio Association (TARA) 14th Annual Hamfest will be held Sunday, June 6th at 11:30 am at Camden Park, Rt. 60 West, Huntington WV. Talk-in W8VA/8 146.04-.64, .16-.76, and .34-.94. For more information and tickets write to: TARA, PO Box 1295, Huntington WV 25715.

BELLEVILLE MI
JUNE 6

The Southeastern Michigan Amateur Radio Hamfest will be held Sunday, June 6, 1976, from 6 am till 4 pm, at the Wayne County Fairgrounds, Belleville, Michigan. 20 minutes from Detroit, 10 minutes from Ann Arbor. I-94 at Belleville Road Exit. Featuring: indoor exhibits, swap and shop, trunk sales, food and refreshments, camping space adjacent to fairgrounds available at a nominal free, and hotel and motel reservations will be available. 5 major prizes. Tickets $2 advance, $2.50 at gate. For more information and tickets write to: Hamfest, Box 1976, Belleville MI 48111. Talk-in 37/97 rpt — 52 simplex. Sponsored by: A.R.R.O.W. Repeater Inc., WR8ADH.

OLD WESTBURY NY
JUNE 6

The Electronic Flea Market sponsored by L.I. Mobile Amateur Radio Club (LIMARC) will be held Sunday, June 6, 1976 from 9am to 4 pm (rain date: June 20) at the N.Y. Institute of Technology, Rte. 25A and Whitney Lane. Admission $1 per buyer; $2 per space seller. For additional information call W2KPQ (516) 938-5661. Talk-in on 25/85.

MANASSAS VA
JUNE 6

The Ole Virginia Hams A.R.C. is sponsoring its second annual Mid Atlantic area "Quality" Hamfest for Sunday, June 6, 1976, at the Prince William County Fairgrounds, Route 234, ½ mile south of Manassas, Va. Directions: take I-95 to Route 234 at Dumfries, Va., or I-66 to the Manassas exit, then south on Route 234. Talk-in on 146.37-97, 147.84-24 and 146-52 simplex. Featuring — large display and exhibit area, electronic flea market, and door prizes. For more information and advanced registrations write to: WA4GVX, 1708 Sharp Drive, Woodbridge VA 22191.

PISCATAWAY NJ
JUNE 6

The Tri-County Radio Association Inc., flea market will be held June 6, 1976 at Nick's Grove, 318 William Street, Piscataway NJ. Opens at 10 am, admission $1, tables $4, half tables $2. Door prizes. Talk-in 146.52, 147.855/147.255. For further information call (201) 725-0778 or (201) 752-4307 or write: PO Box 412, Scotch Plains NJ 07076.

PRINCETON IL
JUNE 6

The Starved Rock Radio Club Hamfest will be held June 6 at the Bureau County Fairgrounds, Princeton, Illinois, same place as last year. Free coffee and doughnuts from 10 to 10:30 am. Camping and trailer space on a first come first served basis for a nominal fee. Official dedication of Starved Rock Repeater by ARRL officials. Advance registration, $1.50 until May 20, after that/or at gate $2.00. For more complete information, motel list, maps, etc., furnish long SASE. For reply, write: Starved Rock Radio Club W9MKS, RFD #1, Box 171, Oglesby IL 61348. (815) 667-4614.

SIOUX FALLS SD
JUNE 12-13

The Sioux Falls Amateur Radio Club, Inc. and the Sioux Valley

Repeater Association, Inc. will hold the 1976 South Dakota Ham Picnic in Sioux Falls on June 12 and 13 at the Sioux Empire Fairgrounds on Sioux Falls' west side, ½ mile east of Interstate 29 and the 12th Street off ramp – follow the "QSY" signs. A talk-in will be on 3950 kHz by the S.F.A.R.C. Club station, WØZWY. Members of the S.V.R.A. will provide information and assistance on the WRØACK 16/76 repeater. For further information, please send an SASE to Sioux Falls Amateur Radio Club, PO Box 91, Sioux Falls SD 57101.

ATLANTA GA
JUNE 12-13

The ARRL Southeastern Division Convention and the Atlanta HamFestival 1976 will be held on June 12-13th at Dunfey's Royal Coach Motor Hotel, I-75 at Howell Mill Road, Atlanta GA. Special HamFestival rates of $16 single, $21 double are in effect. Individual registration is $3 in advance, $4 at door; family registration $5 in advance, $6 at door. Flea market spaces (outdoors) are $5 each, first come, first served. For more information and pre-registration forms, write: Atlanta HamFestival 1976, 53 Old Stone Mill Road, Marietta GA 30062 or telephone area (404) 971-HAMS day or night.

WILLOW SPRINGS IL
JUNE 13

The 19th Annual ABC Hamfest will be held Sunday, June 13, 1976 sponsored by the Six Meter Club of Chicago, Inc. Located southwest of Chicago at Santa Fe Park, 91st and Wolf Road, Willow Springs IL. Advance registration $1.50; at the gate $2.00. Large swap row, picnic grounds, AFMARS meeting, refreshments. Advance tickets from Don Marquardt K9SOA, PO Box 79, Lyons IL 60534 or any club member. Talk-in on 146.94 FM or WR9ABC 37-97 (PL2A).

GRANITE CITY IL
JUNE 13

The Egyptian Radio Club, Inc., W9AIU Hamfest will be held Sunday, June 13, 1976 at the club house located north of Granite City, Illinois, ¼ mile south of the Old Chain of Rocks Canal Bridge. Swapper Row, games for the kiddies, lunch served, cold drinks, ladies' white elephant sale and Bingo. Talk-in on AF9ACA 146.76. Admission free.

ARNOLD MD
JUNE 13

The Maryland Mobileers Amateur Radio Club will hold its Sixth Annual Hamfest on Sunday, June 13, 1976 at Anne Arundel Community College, Arnold, Maryland. Gates open at 9 am. Registration: $2. Tailgaters: $3 plus registration fee. Drawings to be held at 3 pm. First prize: $200 Savings Bond. Talk-ins on 146.10/.70 – 146.52 – 146.16/.76.

AKRON OH
JUNE 20

The Goodyear Amateur Radio Club WA8UXP of Akron, Ohio will hold their 9th Annual Fathers' Day (Hamfest Picnic), on June 20, 1976, at Wingfoot Lake Park located east of Akron, Ohio, one mile west of Suffield, Ohio, on County Rd. #87 and near County Rd. #43. Huge flea market, displays, swap and shop, prizes on the hour, picnic tables available. Adult and children's play area all day. Join us for an enjoyable day of entertainment. Hours: 10 am to 6 pm. Family admission $2 prepaid; $2.50 at gate. For details, tickets, map and program, write to Floyd T. Gilbert WB8ALK, 1976 Newdale Ave., Akron, Ohio 44320.

DUNSEITH ND
JULY 10-11

The 13th Annual International Hamfest is scheduled for July 10 and 11, 1976 at the International Peace Garden between Dunseith, North Dakota and Boissevain, Manitoba. Many prizes to be won. For more information write: Craig R. Schmidt WBØGFZ, Co-Chairman, 1976 Hamfest, Reed Hall #302, North Dakota State University, Fargo ND 58102.

TERRE HAUTE IN
JULY 18

Turkey Run Hamfest has MOVED! New location is the Vigo County Fairgrounds on Highway 41 just South of Terre Haute. There will be prizes galore, lots of flea market space under a roof, XYL Bingo, and plenty of overnight camping will be available. Presale tickets are available 4 for $5 or $1.75 ea. At the gate 3 for $5 or $2 ea. For further information or tickets write to Wabash Valley Amateur Radio Assn., P.O. Box 81, Terre Haute IN 47808.

CANTON OH
JULY 25

The Tusco Amateur Radio Club and the Canton Amateur Radio Clubs are holding their Second Hall of Fame Hamfest on July 25, 1976. It will be held at the Stark County Fairgrounds, Canton, Ohio. This weekend, by the way, is the weekend of the National Pro Football Hall of Fame Football Game and Parade.

MENA AR
SEPT 4-5

The Queen Wilhelmina Hamfest 1976 is Saturday and Sunday, September 4 and 5, at Queen Wilhelmina State Park, Rich Mountain, Mena, Arkansas. Excellent accommodations and food at the newly restored historic Queen Wilhelmina Castle. Door prizes hourly, grand prize, new equipment displays, flea market, camping area with utilities and rest rooms, amusements for harmonics. Talk-in 146.52. For more information write WB5CXX, P.O. Box 5191, Texarkana TX or phone (214) 838-0625.

be my guest

visiting views from around the world

from page 78

considered; therefore, at this level, inputs from them must also be solicited and carefully analyzed. Inputs from other nations and the technology being developed by them might not be bad to know, and an open invitation to a representative from Europe or another part of the world could go a long way in cementing relations between us. We might just learn a little from their work. Think I am kidding? Just look at the latest *73 World Atlas of Repeaters*. They're right in there with us.

It would be important to us to develop an ongoing and open dialogue with the Federal Communications Commission, and a representative of the Amateur and Citizens Division should be invited to attend every one of these meetings. With deregulation now a reality, it is very important for them to know that we are willing and able to be the self-directing service that we want to be and that we have developed the necessary structure to insure this. By inviting both their participation and comment at such meetings, we can help foster this deregulation trend, since they will then be getting regular feedback on how things are going (and getting this directly from those chosen by us to represent us). If you lived through the years of 18803 (you can see that repeaters and FM are my special interest) and never want to see a repeat of things such as this, then an ongoing dialogue on a national level between the Commission and the amateur community is essential.

Finally, it is important to let the Directors of the League know what our wants and desires are, so that they can be directed to work toward these goals. At the same time, they too might have ideas on the same subjects that they wish to put forth to us. For this reason, a direct dialogue between the ARRL Board of Directors and this top drawer committee must also exist. While some may not believe it, in the past few years there has been a marked shift within the League management toward listening to and acting upon the many diverse needs of the amateur community. However, they can only act if input is provided, and for that reason a direct liaison between the two is mandatory. It was seeing this change begin that gave rise to my decision to join the ARRL – and, hopefully, help foster its continuance.

So there you have it: a voluntary coordination plan that encompasses all interested amateurs, provides for the needs of all modes and all special interests, is totally elective in nature, and offers the possibilities of international ties. A pipe dream you say; maybe so, but with a little work and commitment on the part of each individual amateur, it or something similar can be a reality. I do not offer this as a solution to the problems that plague us now or that will plague us in the future, but rather as a starting point from which to build. Let's exchange ideas and come up with a plan that not only will benefit us now, but also will never become obsolete in the future.

This leaves us with two questions (perhaps many others, but these two seem key). Where did I get this idea? And, is it really all that necessary? The where is easy: It is nothing more than the ideas of many amateurs with whom I have spoken who are concerned about the future. All that I have done is take their views and my own and collate them into some viable form – some starting point from which to build. But is it necessary to do so? At this moment, the answer is yes and no, depending upon where you happen to live. If it's in an area with a limited number of amateurs and limited VHF activity, the answer is no. However, the majority of this operation is concentrated in large and crowded urban areas, and in some places we are beginning to step on one another's toes. This can only lead to dissension within our ranks, unless we do something now. If this is to be the case, we must be farsighted enough to give all involved some voice, and must be democratic about the way we handle such an effort. We must not appoint from outside but rather be left free to determine our own destiny through due democratic process. What you have just been presented is, I hope, a true "Representative Democratic Republic" with which to begin preparing for the future.

In closing, let me pose the following. For many a moon we hollered for deregulation so that we would be free to continue building toward a free and viable amateur radio community. The Commission has now started to grant our requests, so I only ask if we are prepared to meet and accept both the challenge and obligation that this puts before us. Individually we cannot do it alone, but collectively, on a voluntary basis, the future can be bright and fruitful.

Your comments, and ideas and recommendations are gratefully accepted.

Bill Pasternak WA6ITF
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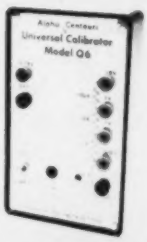

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LETTERS

from page 113

interested in transistors? The stuff in BYTE is so far over my head that I don't really look on that as being helpful to most of us ... and it certainly isn't ham oriented. Okay? Now stop fussing and start reading those articles ... we've gone to a lot of trouble to get them into the magazine so you will know what is what with this new equipment ... the most amazing component in the history of electronics. – Wayne.

RINGING A BELL

J. K. Bach's article in the March issue of *73* rang a bell. I hope this information will be useful to other ten dollar calculator buyers.

The "Accumatic" calculator I bought several years ago (for considerably more than ten dollars, unfortunately) was marketed by Lloyd's Electronics, Inc., 18601 S. Susana Road, Compton CA 90211. My calculator was exactly like the one Mr. Bach bought for ten bucks – it didn't work either. The problem was a shorted capacitor – C8 – which prevented the display from clearing. By replacing C8, I finally got rid of the 8s, and the display zeroed nicely. Since the instruction manual I received with the calculator was even more vague and incomplete than the one the author describes, I was content with an operating display and reasonably good battery life. The "Accumatic" performed fairly well, if slowly, for the next few months until I sold it and bought one of the fancier models with a memory and square root functions.

John C. Mutzabaugh WNØQEA
Grand Forks ND

P.S. By the way, I thoroughly enjoy *73* – if more hams had your attitude, the future of amateur radio would be a hell of a lot brighter.

RFI LEGISLATION

On 25 February 1976, The Honorable Barry Goldwater (Arizona) introduced radio-frequency interference (RFI) legislation into the U.S. Senate. The bill, S. 3033, is virtually identical to the RFI bill introduced into the House of Representatives last year by Mr. Charles A. Vanik.

Mr. Goldwater's bill has been referred to the Senate Commerce Committee, and so, interested readers should forward their comments on the bill to: The Honorable John O. Pastore, Chairman, Communications Subcommittee, Senate Commerce Committee, United States Senate, Washington, D.C. 20510.

Letters may also be sent to one's senators at the following address: The Honorable . . ., United States Senate, Washington, D.C. 20510.

Correspondence should indicate that a similar measure is awaiting hearings in the House of Representatives (H.R. 7052).

Theodore J. Cohen W4UMF
Secretary
RFI Task Group
Alexandria VA

MAPLE HILL

"This is W5LSF, Rockwall, Texas, near Dallas . . . we read you loud and clear . . . greetings to the Castleton Kiwanis!" This message filled the hall where the Castleton Kiwanis club met recently as students Jim Zalinka and Ann Ryan joined me in a demonstration of "ham" or amateur radio. Joining the Kiwanis at the invitation of Mr. Harry Hallenbeck, my students and I set up two portable stations using equipment and antennas made by Maple Hill High School's Amateur Radio Club. After explaining the workings of their school station and showing cards collected from stations "worked" all over the world, the students distributed free literature and gave a demonstration. Despite bad weather and band conditions, the station near Dallas was contacted as part of the demonstration on "DX" or distance communications. Another demonstration showed local FM communication, using repeaters.

As part of their training for radio licenses, a group of 5 Maple Hill students recently visited amateur radio operator Joseph Battaglia WB2QEH of Schenectady, who's been on the air since 1918. Joe showed his equipment to students Geoff Schad, Bob Porter, Al Ferreira, Scott Van Nederynen and Jim Zalinka, who accompanied me on the visit. Joe was particularly proud to show how he restores old radio equipment and experiments with new antennas, both prized amateur radio skills.

Maple Hill High's radio station and program have recently been recognized by two national amateur radio magazines, *QST* and *CQ*.

John Kienzle WA2UON
Castleton NY

SAD PARAGRAPH

OK, here it is. Your sad paragraph in your editorial about the reader service card got to me. I have circled the appropriate alphanumerics and am writing this, my first letter ever to a magazine. It's just that I like *73* a lot and would like to make your advertisers happy. As you will note from the checked box, my copy was obtained at a newsstand (ham store). This is because of thiefs in my apartment house. It seems they like all the same mags that I do, so I am forced to buy at the store. Well, that's life.

Keep up the computer articles. I am about to buy an Altair 8800 and my knowledge of computers is about equal to yours, so I need all the info I can get. Thanks for a swell mag.

R. L. Turner K7MRB
Seattle WA

DOLLAR FOR DOLLAR

Your new format has certainly improved the appearance of *73 Magazine* and made for much easier reading with the larger print. Congrats!

I would like to hear from any of your readers who are ham operators and former members of the Lone Scouts of America.

August Karvonen K8HHZ
Mass MI 49948

Thought I would drop you a line and let you know that I really enjoy your new format for *73 Magazine*. Dollar for dollar it is still the best radio magazine around. Keep up the good work. I really enjoy reading your editorials, as they sometimes step on toes that need to be stepped on.

I operate CB here as well as ham radio, and I find most of the people here in this area very conscious of proper procedure and identification with the proper callsign as issued by the FCC. Not all of us CBers are bad. I have been a licensed ham for 16 years and have found a use for both ham radio and CB radio in my personal and professional life.

Billy L. Nielsen WB4APC
Radcliff KY

HBØ DXPEDITION

Please be advised that the Wiesbaden Amateur Radio Club is planning an HBØ Dxpedition. Dates are from 26 May 76 through 2 June 76. We will be using an HBØ call as a club call.

The bands worked will include the following: 80, 40, 20, 15, 10 and 2 meters. Frequencies to be used are not firm and we do plan to operate in the Novice portion of the bands.

QSL will be via the German DARC and DA1DM, or as given during QSO.

Dennis F. Miller WB5KEA/DA1DM
APO NY

THEY'LL BE THERE

Are you following us around? Last summer, just after we opened a CB shop, you came up with a ham who suggested us amateurs open CB shops. Now comes your April issue – asking about CB bootleggers on 10 and 15. Ron (W5SUH) and I (WN5PKE) also sell and service ham equipment. Sideband has proven fascinating for some of our CB customers, and since we keep ham equipment on display, they ask about it, also.

With this group, Ron has made it so interesting that they've started Novice classes. Last night we had 18 members in the class. Pretty good for a farming community of 2400, don't you agree? Some of these CBers drive 60 miles one way for this class.

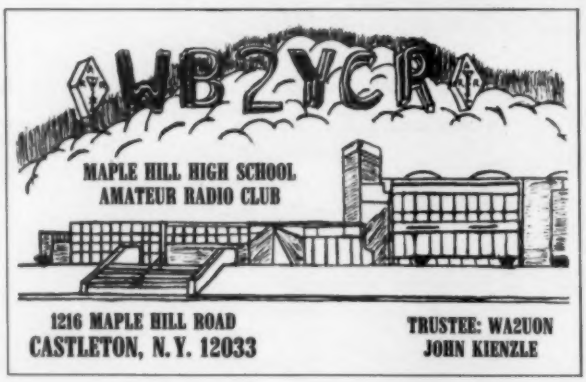
The answer? Make it sound and *be* interesting – start explaining, and take time to convert them.

As I'm writing this, one of our students is reading your article. He says, "Tell them I agree – let's keep those of us who don't know anything off until we *do* know what we're supposed to know."

We've met with so much more interest from these more-intrigued CBers than we have from the general public. Can we hams look at the CBers as a "natural resource," waiting to be tapped?

Look for our students in the '77 callbook. They'll be there!

Carol Gamel WN5PKE
Checotah OK



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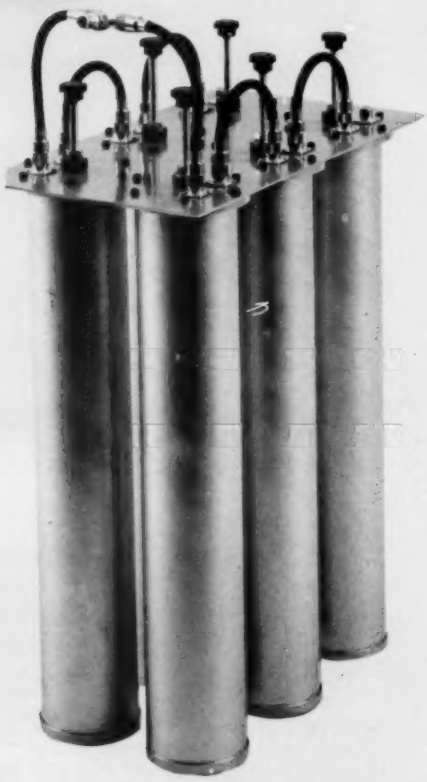

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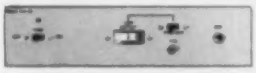

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NEW PRODUCTS

NEW WILSON 1405SM THOROUGHLY TESTED

Wilson has come up with a five Watt HT ... shades of the old Motorola HT-220 for you old timers in FM. The Wilson has the enormous benefit of having a 1 W/5 W switch so you don't *have* to run the battery down at the high output rate.

Naturally I felt that it was important to put the Wilson through a really rigorous test. After a lot of thought, the decision was made to check it out under the worst possible conditions ... while skiing at Aspen, Colorado. Here it would have to be subjected to temperature extremes, altitude extremes, long periods of use without recharging, plus plenty of physical abuse whenever I fell down on it.

Aspen would be a great two meter FM area if there was a repeater set up on a mountain across town. The four main ski areas are all in a row, running about ten miles from the center of town. The result is that when one is skiing on one side of a mountain at one end of the chain it is difficult to get through to someone skiing on the other side of a mountain on the other end of the chain. This is where the five Watts really turned the trick. Time after time I was able to shake up the troops several mountains away by blasting them with the high power position.

The unit sucks 900 mA in "high" so prudence calls for moderation and use of the 1 W level when the 5 W isn't actually needed. It only drags 400 mA in low.

A friend of mine once pointed out that "for a few cents extra you go first class." He was right, in general, and thusly I had the TT pad on my 1405SM. Now, I'll admit that there are not a lot of autopatch repeaters in Aspen ... none, in fact. But that in no way stopped me from expansively pointing out to any non-ham who showed even slight interest that, oh yes, we could make telephone calls with the HT.

It's funny about an HT ... you can go along for years not owning one and in some way get by. But once you have it you find that it is in constant use. Some chaps wear the damned things almost 24 hours a day, which to my mind is carrying hamming too far. Most of these chaps are single ... or at least they are single now.

The 1405, being a bit smaller than the older Wilson HTs, fit even better into my ski parka pocket. I didn't take any spectacular flops on it, but I did manage to check out its survivability under impact a few times ... like the time I came sailing into the middle of the bus stop area at the end of the day going at an impressive clip ... I did a quick hockey stop in a casual and very masterful way ... and caught the edge of my ski in a rut and went skidding on the HT over the ice for about six feet. Damned people didn't have anything better to do than stand around snickering. The HT worked fine.

I like the Wilson because it is easy to get into for changing crystals ... it has six (6) channels, which is very handy if you are going to be around a few repeaters and also need a couple of direct channels. The batteries are very easy to access ... this was particularly valuable for me because my charger got swiped from my hotel room within a couple hours of my arrival in Aspen, and I had to jury rig a charging setup with a couple clip leads into a Motorola charger. It kept me on the air. I did find that when I kept to the 1 W position I could use the HT for two or three days before the battery meter began to indicate a weakening condition. I left it on receive all day so I could hear any calls from the other four skiers.

A group of amateurs with HTs is a fun thing under almost any circumstances ... and skiing is particularly great. Even though you are divided up and not skiing together, you are in constant touch.

Wayne Green W2NSD/1

VHF ENGINEERING ANNOUNCES TWO NEW POWER SUPPLIES

VHF Engineering, of Binghamton, N.Y., has announced two new high current, regulated 12 volt power supplies for use in amateur and commercial applications.

The two supplies have ratings of 15 Amps and 25 Amps, over voltage ranges of approximately 10-14 V dc and 10-14 V dc respectively. Load regulation is 2% from no load to maximum rated current.

These new supplies feature both over-voltage protection and foldback current limiting. The over-voltage protection is provided by a crowbar circuit which will shut down the supply if the output voltage exceeds 14 V. This feature protects the equipment being powered from damage due to over-voltage in the event of a malfunction within the supply. The foldback limiting circuit limits the output current to a maximum of 1 Amp in the event that the output is shorted. This feature protects the power supply from damage and prevents high currents from flowing into a piece of equipment which has developed an internal short. When the short is removed, the power supply returns to normal.

These regulated power supplies have been designed to high commercial standards through the use of epoxy glass, tinned circuit boards, along with high quality components. They may be purchased directly from VHF Engineering, 320 Water St., PO Box 1921, Binghamton NY 13902, or from distributors nationwide. The 15 Amp supply (PS-15C) sells for $79.95 in kit form and $94.95 wired and tested. The 25 Amp supply (PS-25C) sells for $129.95 as a kit and $149.95 wired and tested.

George R. Allen W1HCI

MORE ON THE TWO-TIMER

(April, 1976, p. 106)

Nexus Trading Company will provide a free information package with board layouts for the Two-Timer clock, upon receipt of an SASE. An etched and drilled board set is available for $8.95. Specify .3" or .6" readouts.

briefs

The WC calls you may begin to hear soon on the ham bands aren't Novices in the Caroline Islands or newly licensed hams; they are **RACES** calls. In the Report and Order on Docket 19723, the FCC rewrote the RACES rules to affirm that all such stations must be controlled by licensed amateurs. All amateur frequencies may be used by RACES stations, except in times of declared emergencies, and tactical callsigns will be abolished. RACES repeater operation will use the WC-R bloc of calls.

Club station applicants no longer have to supply a copy of the club constitution and bylaws, but the FCC has announced that a club must, to be licensed, have at least two members (one licensed), a name, constitution, and amateur radio as its primary purpose.

The trial program of using the **Civil Service** system to administer amateur examinations has ended; the commission has decided to retain that function except in outlying areas where a field office is very distant. The program did not receive as much interest as anticipated.

More deregulation: The word "intracommunity" has been struck from the FCC's definition of a repeater station, in keeping with the permissibility of multiple repeater links. "DX" repeaters are now not in keeping with the spirit of the rules.

Ten meter repeaters are now beginning to appear; WR1AAA in Malden MA had the first reported ten meter system, operational in February. Now if only there were sunspots ...

License guide publishers were up in arms when the **ARRL** sent a letter to advertisers implying that their forthcoming Novice text would be recognized by the FCC as the only official text, and that passing a course administered by an ARRL club would be the primary route to a Novice license in the future. In fact, the FCC has not given the ARRL any special status, and is contemplating letting local clubs certify Novice class graduates, to lessen the test grading load at Gettysburg. Details remain to be worked out.

27 MHz CB expansion had been tentatively scheduled for announcement around April Fools' Day, but was put off for perhaps a year at the last minute. It seems that the proposed new channels were 455 kHz away from existing channels, and i-f frequency intermod would have caused interference to other services. New frequencies are still being sought somewhere in the spectrum.

The FCC has waived the rules to permit **ATV repeaters** to operate in the 420 MHz band outside of normal repeater allocations, for a one year period ending next March. WR4AAG near Washington DC had been operating with 439 MHz input, 427 MHz output for some time with temporary authorization; future ATV repeaters will probably be covered by a coordination plan that has yet to be worked out.

The **HIRAN docket** to permit offshore nongovernmental radiolocation services to share the 450 MHz ham band has been acted upon; such services will be permitted on a case-by-case basis. Amateurs had expressed dissatisfaction with the idea, but few complaints of interference arose from previously authorized stations. Amateurs are expected to scream like mad if they receive interference, as they have priority there.

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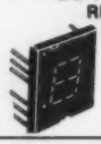

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Units tested for 500NS Speed.

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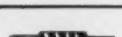

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Before the
Federal Communications Commission
Washington, D.C. 20554

FCC 76-130
39213

In the Matter of

Deregulation of Subpart F, Radio Amateur Civil Emergency Service (RACES), in Part 97

Docket No. 19723

RM-968, RM-1116, RM-1478, RM-2032, RM-2154, RM-2168

REPORT AND ORDER
(PROCEEDING TERMINATED)
Adopted: February 11, 1976;
Released: February 19, 1976

By the Commission: Commissioner Reid concurring and issuing a statement in which Chairman Wiley and Commissioner Hooks join.

1. On April 18, 1973 the Commission adopted a Notice of Inquiry in Docket 19723, FCC 73-40, which was published in the Federal Register on April 27, 1973, 38 F.R. 10467 (1973). In adopting the Notice of Inquiry the Commission sought comments on several matters fundamental to the future structure and organization of the Radio Amateur Civil Emergency Service (RACES). We particularly wished to receive from informed parties comments concerning the effectiveness of the present RACES program, the type of RACES program, if any, that should be continued, the objectives RACES should attempt to achieve, and the way in which RACES should be structured to achieve those objectives.

2. The Commission received some one hundred thirty comments in response to its Notice of Inquiry, and on June 12, 1974 we adopted a Notice of Proposed Rulemaking in this proceeding, FCC 74-609, which was published in the Federal Register on June 24, 1974, 39 F.R. 22282 (1974). Comments were invited from interested parties and were due on or before September 25, 1974. Reply comments were due on or before October 10, 1974.

3. In our Notice of Proposed Rulemaking we proposed to simplify greatly those sections of Part 97 concerning RACES by:

(a) Making all licensed amateur radio operators and stations eligible for participation in RACES, provided such operators and stations are registered with and enrolled in a civil defense organization;

(b) Discontinuing present requirements for RACES Communications Plans, FCC Certifications and Authorizations (FCC Forms 481 and 482);

(c) Permitting RACES station licenses to be issued directly to civil defense organizations;

(d) Providing, except during emergencies, for the shared use of amateur frequencies between amateur and RACES stations on a first-come-first-served basis;

(e) Requiring control operators of RACES stations to be licensed amateur radio operators and making operator privileges in RACES identical to those held in the Amateur Radio Service;

(f) Limiting useage of RACES stations to bona fide civil defense emergencies and up to one hour per week of drills and tests;

(g) Abolishing tactical or secret call signs, currently authorized by Section 97.213 of the Rules, assigning the same distinctive two letter call sign prefix to all RACES stations to facilitate their identification as RACES stations, and requiring all other amateur stations participating in RACES to use their regular assigned call signs when participating in RACES/civil defense activities;

(h) Limiting permissible communications of RACES stations and amateur stations operating in RACES to communications with RACES stations, amateur stations participating in RACES, and those other stations listed in proposed Section 97.189.

4. We received comments representing the views of approximately one hundred fifty individuals and organizations in response to our Notice of Proposed Rulemaking in this proceeding. Our respondents included the Secretary of Defense, fifteen state civil defense agencies, forty municipal or county civil defense organizations, and sixteen amateur clubs and organizations, among them the American Radio Relay League (ARRL). All comments received have been carefully analyzed by the Commission's staff, and we are now prepared to undertake final action in this Docket.

5. Comments on the broad contours of our proposal ranged from several expressing the opinion that RACES has become little more than an extension of local government used by elected officials when normal radio frequencies are busy, and which should therefore be removed from the amateur service entirely, to others viewing strict local government control of RACES to be absolutely essential and requesting more, rather than less, Commission regulation of RACES.

6. Comments received on the proposed amendments were generally favorable. Typical was the response of the Secretary of Defense, who characterized the proposal as an "admirable step towards simplifying the unduly complex RACES licensing procedures." Similarly, the ARRL agreed "in principle with the modifications to the RACES rules proposed by the Commission . . ."

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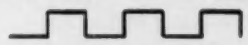

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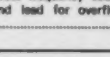

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7. While several comments cited the absence of either RACES organization or activity in the respondents' areas as evidence justifying total elimination of RACES everywhere, others indicated RACES to be precisely the sort of highly organized and effective means of emergency communications so vital in times of man-made and natural disasters.

8. Accordingly, we reaffirm those findings outlined in our Notice of Proposed Rulemaking in this proceeding, namely, that there does exist today a definite need in some areas for the type of service RACES is intended to provide, and that such a communications network should at least be available to those communities desiring it. In this Report and Order, therefore, we are adopting the amendments contained in our Notice of Proposed Rulemaking essentially as proposed and as set forth in the Appendix hereto.

9. Although we are adopting the amendments to Part 97 generally as proposed, several questions concerning specific sections of the Docket merit separate discussion.

10. That section of the proposed amendments making all licensed amateur radio operators, regardless of license class, eligible for participation in RACES was almost universally accepted. Recent trends, such as the burgeoning number of repeaters available for amateur use, have amply demonstrated the utility of the VHF bands in providing dependable communications. A large segment of the VHF user population consists of Technician Class licensees, and since these licensees have proven themselves in the past to be highly qualified communicators, we perceive no reason for denying such a resource to those RACES organizations desiring to utilize it.

11. Our proposal to eliminate present requirements for RACES Communications Plans, FCC Certifications and Authorizations (FCC Forms 481 and 482) met with general approval, and we believe such deletion to be consonant with recent Commission attempts to simplify and deregulate the Amateur Radio Service. Thus, filing of FCC Forms 481 and 482 will no longer be required to obtain RACES authorization. We appreciate the position of those governmental entities such as the State of California expressing both concern over elimination of these requirements and fear that lack of provision for formal communications plans and frequency coordination will create confusion and limit the usefulness of RACES. We believe, on the contrary, that because RACES is at its base an amateur service, a service traditionally characterized by voluntary cooperation between groups and individuals, such apprehension is not warranted. Those civil defense organizations wishing to do so may of course establish communications plans and coordinate frequencies as extensively as they wish. In the future, however, such planning will be a matter for civil defense authorities and amateurs, not the Commission.

12. The proposals permitting RACES station licenses to be issued directly to civil defense organizations and providing for the shared use of all amateur frequencies between amateur and RACES stations on a first-come-first-served basis encountered relatively little opposition. Those respondents critical of the proposed amendments contended, in substance, that to permit use of amateur frequencies by amateurs and RACES groups would make effective civil defense emergency frequency planning difficult. The primary fear appears to be that unless specific frequencies are assigned for exclusive RACES use, interference from amateurs may be sufficient to render RACES communications impossible. We note, however, that the Commission may in the future, as now, designate frequencies for RACES use in the event of emergency under the provisions of Section 97.107 of the Rules, and would observe, further, that amateurs have a long tradition of voluntary cooperation in emergency situations, a tradition we have every reason to believe will continue in the future. We conclude, therefore, that their exists no real basis for concern in this regard.

13. Our proposal to require control operators of RACES stations to be licensed amateurs proved to be somewhat controversial. Many respondents, particularly those representing governmental and RACES organizations, expressed the belief that in requiring RACES operators to be in all cases licensed amateurs we would be severely limiting RACES' usefulness. A commonly articulated concern was that in many areas of the country, especially rural areas, there are few amateur licensees, and that for RACES to be a functional service it may in some instances be essential for local RACES officers to recruit as RACES operators personnel holding Commission commercial licenses, a practice currently authorized by Section 97.203 of the Rules. Several of our respondents also attempted to justify operation by commercial licensees on amateur frequencies by noting that some RACES stations are manned twenty-four hours per day and that volunteer amateurs may be unwilling to serve on an around the clock basis. Further, a few comments stated that because many disasters strike with great swiftness, effective use of RACES stations virtually dictates use of commercial operators, at least until amateur operators are available to man the stations. As outlined by the Secretary of Defense, commercial licensees are necessary in such situations to "provide the official direction and supervision needed in the case of an emergency ... [to] fill the interstices caused by the inability of amateurs to provide sufficient communications support in a given area." Assuming, without deciding, these arguments to be valid, we nonetheless believe

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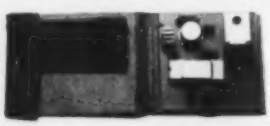

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they ignore the fundamental principle inherent in RACES, namely, that it is an amateur service. The proposition that there can be any circumstances whatsoever in which commercial operators may operate on amateur frequencies is contrary to the definition of the service found in Section 97.3 of the Rules and is conceptually unacceptable. We believe that if RACES cannot function without commercial operators, it should probably be removed from Amateur Radio Service frequencies entirely.

14. Much of what was said in the preceding paragraph applies with equal force to the problem of the scope of operating privileges to be extended amateur operators participating in RACES. Consistent with our desire to make RACES an integral part of the amateur service, we are herein adopting Section 97.179 as proposed and making operator privileges in RACES identical to those held in the amateur service. While we anticipate that some RACES organizations will be inconvenienced in ensuring their operators utilize only those frequencies available under the terms of their licenses, we believe any such inconvenience will be far outweighed by the benefits to be realized in making RACES an integral part of the Amateur Radio Service.

15. Much concern was also expressed over limiting useage of stations participating in RACES to bona fide civil defense emergencies and a maximum of one hour per week of drills and tests, as proposed in Section 97.191. Such a limitation on drills, some contended, is unrealistic because it often takes longer than one hour simply to call the roll and attend to other administrative matters on a RACES network. We are not persuaded by such arguments. While some of the larger RACES networks may be forced to adopt more efficient methods of operation to comply with the new time limitation, we believe most RACES operations will not be seriously affected. Those amateurs wishing to sharpen their network traffic handling skills beyond that they are able to acquire as RACES participants may of course do so through those amateur networks organized for this purpose.

16. Our proposal to eliminate tactical call signs, assign distinctive call signs to RACES stations, and require amateur stations participating in RACES to use their amateur call signs was criticized by several of the larger civil defense organizations. These respondents stated, in substance, that such a change in standard RACES operating procedure would engender confusion, cause unnecessary delay, and make network operation generally less efficient. We believe, however, that operation on amateur frequencies should whenever possible conform to accepted amateur practice, and that by requiring the use of amateur call signs on RACES networks we are taking an appropriate step in that direction. New RACES stations or those renewing their licenses after the effective date of these amendments will be assigned call signs with a prefix of "WC" followed by the appropriate amateur call sign district indicator and three letters. RACES repeater stations will be assigned call sign suffixes beginning with "R".

17. Several comments alleged that limiting permissible communications of RACES stations and amateur stations participating in RACES to communications with RACES stations and those other stations listed in proposed Section 97.189 would reduce RACES network effectiveness in time of emergency. A few respondents suggested that non-RACES amateurs may be in positions to render valuable assistance to RACES operations in emergency situations, and that, in any event, in light of the proposed amendment discussed in the preceding paragraph, requiring amateur stations participating in RACES to use their amateur call signs, such a prohibition would be unenforceable. While conceding the obvious difficulties involved in enforcing Section 97.189 as proposed, we note the long self-policing history of the Amateur Service and conclude that enforcement will not constitute a serious problem. At the root of proposed Section 97.189 is the notion that RACES is a discrete system within the Amateur Service, designed to provide specific types of communications in narrowly defined situations. We believe, therefore, that only these stations registered in RACES should be permitted to communicate with RACES stations, and *vice versa*. We would observe, however, that there is nothing to prevent amateur stations registered in RACES from taking part in other organized and unorganized amateur activities and communicating with non-RACES amateur stations in those contexts.

18. Some comments raised questions concerning the definition of "RACES station" in proposed Section 97.163(b). They asked whether the language "specific land location" meant such a station could be operated as a portable station. The answer is "yes": a RACES station may be operated portable in the same fashion as any other amateur station. We merely require that the licensed station location be a "specific land location."

19. Finally, we would note that because all amateur frequencies are now available for RACES use, repeater stations operating in RACES may now make full use of those frequencies allocated for repeater useage in the Amateur Service. The limitations of proposed Section 97.185 apply only in those emergencies requiring invocation of the President's War Emergency Powers under Section 606 of the Communications Act of 1934, as amended.

20. In view of the foregoing, we believe these amendments of Part 97 of the Rules to be in the public interest, convenience, and necessity.

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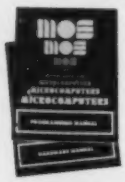

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21. Authority for the rule changes adopted herein is contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended.

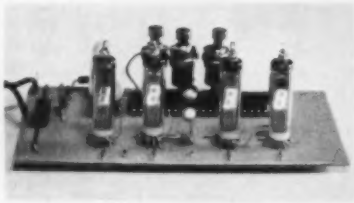
22. These amendments shall become effective upon the date specified in paragraph 23. In order to avoid undue hardship, existing RACES stations may continue to operate under their current authorizations and the existing Rules until the expiration date of their licenses. If the expiration date of an existing RACES station license is less than one year and six months from the effective date of these amendments, it may be renewed upon proper application for a period of one year, during which time the existing rules shall continue to apply. All other new and renewed RACES licensees shall comply with the rules as amended. Each new RACES station application shall be submitted on an FCC Form 610-B, with an indication it is a RACES station application.

23. Accordingly, IT IS ORDERED that Part 97 of the Commission's Rules IS AMENDED as shown in the Appendix attached hereto effective March 23, 1976. IT IS FURTHER ORDERED that this proceeding is TERMINATED.

FEDERAL COMMUNICATIONS COMMISSION*
Vincent J. Mullins
Secretary

*See attached Concurring Statement of Commissioner Reid in which Chairman Wiley and Commissioner Hooks join.

NOTE: Rules changes herein will be covered by T.S. VI(75)-3.



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APPENDIX

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended in its entirety as follows:

SUBPART F – RADIO AMATEUR CIVIL EMERGENCY SERVICE (RACES)

General

§97.161 Basis and purpose.

The Radio Amateur Civil Emergency Service provides for amateur radio operation for civil defense communications purposes only, during periods of local, regional or national civil emergencies, including any emergency which may necessitate invoking of the President's War Emergency Powers under the provisions of §606 of the Communications Act of 1934, as amended.

§97.163 Definitions.

For the purposes of this Subpart, the following definitions are applicable:

(a) *Radio Amateur Civil Emergency Service.* A radiocommunication service conducted by volunteer licensed amateur radio operators, for providing emergency radiocommunications to local, regional, or state civil defense organizations.

(b) *RACES station.* An amateur radio station licensed to a civil defense organization, at a specific land location, for the purpose of providing the facilities for amateur radio operators to conduct amateur radiocommunications in the Radio Amateur Civil Emergency Service.

§97.165 Applicability of rules.

In all cases not specifically covered by the provisions contained in this Subpart, amateur radio stations and RACES stations shall be governed by the provisions of the rules governing amateur radio stations and operators (Subparts A through E of this part).

Station Authorizations

§97.169 Station license required.

No transmitting station shall be operated in the Radio Amateur Civil Emergency Service unless:

(a) The station is licensed as a RACES station by the Federal Communications Commission, or

(b) The station is an amateur radio station licensed by the Federal Communications Commission, and is certified by the responsible civil defense organization as registered with that organization.

§97.171 Eligibility for RACES station license.

A RACES station will only be licensed to a local, regional, or state civil defense organization.

§97.173 Application for RACES station license.

(a) Each application for a RACES station license shall be made on the FCC Form 610-B.

(b) The application shall be signed by the civil defense official responsible for the coordination of all civil defense activities in the area concerned.

(c) The application shall be countersigned by the responsible official for the governmental entity served by the civil defense organization.

(d) If the application is for a RACES station to be in any special manner covered by §97.41, those showings specified for non-RACES stations shall also be submitted.

§97.175 Amateur radio station registration in civil defense organization.

No amateur radio station shall be operated in the Radio Amateur Civil Emergency Service unless it is certified as registered in a civil defense organization by that organization.

Operating requirements

§97.177 Operator requirements.

No person shall be the control operator of a RACES station, or shall be the control operator of an amateur radio station conducting communications in the Radio Amateur Civil Emergency Service unless that person holds a valid amateur radio operator

license and is certified as enrolled in a civil defense organization by that organization.

§97.179 Operator privileges.

Operator privileges in the Radio Amateur Civil Emergency Service are dependent upon, and identical to, those for the class of operator license held in the Amateur Radio Service.

§97.181 Availability of RACES station license and operator licenses.

(a) The original license of each RACES station, or a photocopy thereof, shall be attached to each transmitter of such station, and at each control point of such station. Whenever a photocopy of the RACES station license is utilized in compliance with this requirement, the original station license shall be available for inspection by any authorized Government official at all times while the station is being operated and at other times upon request made by an authorized representative of the Commission, except when such license had been filed with application for modification or renewal thereof, or has been mutilated, lost, or destroyed, and request has been made for a duplicate license in accordance with §97.57.

(b) In addition to the operator license availability requirements of §97.83, a photocopy of the control operator's amateur radio operator license shall be posted at a conspicuous place at the control point for the RACES station.

Technical requirements

§97.185 Frequencies available.

(a) All of the authorized frequencies and emissions allocated to the Amateur Radio Service are also available to the Radio Amateur Civil Emergency Service on a shared basis.

(b) In the event of any emergency which necessitates the invoking of the President's War Emergency Powers under the provisions of §606 of the Communications Act of 1934, as amended, unless modified or otherwise directed, RACES stations and amateur radio stations participating in RACES will be limited in operation to the following:

Frequency or Frequency Bands		
kHz		Limitations
1800-1825		1
1975-2000		1
3515-3550	~	2, 4
3984-4000		
3997		3
7097-7103		4
7103-7125		2, 4
7245-7255		2, 4
14047-14053		4
14220-14230		2, 4
21047-21053		4
MHz		
28.55-28.75		
29.45-29.65		
50.35-50.75		
53.30		3
53.35-53.75		
145.17-145.71		
146.79-147.33		
220-225		5

(c) Limitations:

(1) Use of frequencies in the band 1800-2000 kHz is subject to the priority of the Loran system of radionavigation in this band and to the geographical, frequency, emission, and power limitations contained in §97.61 of the rules governing amateur radio stations and operators (Subparts A through E of this part).

(2) The availability of the frequency bands 3515-3550 kHz, 7103-7125 kHz, 7245-7247 kHz, 7253-7255 kHz, 14220-14222 kHz, and 14228-14230 kHz for use during periods of actual civil defense emergency is limited to the initial 30 days of such emergency, unless otherwise ordered by the Commission.

(3) For use in emergency areas when required to make initial contact with military units; also, for communications with military stations on matters requiring coordination.

(4) For use by all authorized stations only in the continental United States, except that the bands 7245-7255 kHz and 14220-14230 kHz are also available in Alaska, Hawaii, Puerto Rico, and the Virgin Islands.

(5) Those stations operating in the band 220-225 MHz shall not cause harmful interference to the government radiolocation service.

§97.189 Points of communications.

(a) RACES stations may only be used to communicate with:

(1) Other RACES stations;

(2) Amateur radio stations certified as being registered with a civil defense organization, by that organization;

(3) Stations in the Disaster Communications Service;

(4) Stations of the United States Government authorized by the responsible agency to exchange communications with RACES stations;

(5) Any other station in [illegible] service regulated by the Federal [illegible] tions Commission, whenever such [illegible] is authorized by the Commission to [illegible] communications with stations in the [illegible] Amateur Civil Emergency Service.

(b) Amateur radio stations registered with a civil defense organization may only be used to communicate with:

(1) RACES stations licensed to the civil defense organization with which the amateur radio station is registered;

(2) Any of the following stations upon authorization of the responsible civil defense official for the organization in which the amateur radio station is registered:

(i) Any RACES station licensed to other civil defense organizations;

(ii) Amateur radio stations registered with the same or another civil defense organization;

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We are authorized distributors for: Icom and Standard Communications Equipment. (2 meter)

Note: If you do not know type of radio, or if your radio is not listed, give fundamental frequency, formula and loading capacitance.

LIST OF TWO METER CRYSTALS CURRENTLY STOCKED FOR RADIOS LISTED BELOW:

1●. Drake TR-22
2●. Genave
3●. Icom/VHF Eng.
4●. Ken/Wilson /Tempo FMH
5●. Regency HR-2A/HR212/Heathkit HW-202
6●. Regency HR-2B
7●. S.B.E.
8●. Standard 146/826
9●. Standard Horizon
10●. Clegg HT-146

The first two numbers of the frequency are deleted for the sake of being non-repetitive. Example: 146.67 receive would be listed as – 6.67R

1. 6.01T	9. 6.13T	17. 6.19T	25. 6.31T	33. 6.52T	41. 7.03R	49. 7.15R	57. 7.27R	
2. 6.61R	10. 6.73R	18. 6.79R	26. 6.91R	34. 6.52R	42. 7.66T	50. 7.78T	58. 7.90T	
3. 6.04T	11. 6.145T	19. 6.22T	27. 6.34T	35. 6.55T	43. 7.06R	51. 7.18R	59. 7.30R	
4. 6.64R	12. 6.745R	20. 6.82R	28. 6.94R	36. 6.55R	44. 7.69T	52. 7.81T	60. 7.93T	
5. 6.07T	13. 6.16T	21. 6.25T	29. 6.37T	37. 6.94T	45. 7.09R	53. 7.21R	61. 7.33R	
6. 6.67R	14. 6.76R	22. 6.85R	30. 6.97R	38. 7.60T	46. 7.72T	54. 7.84T	62. 7.96T	
7. 6.10T	15. 6.175T	23. 6.28T	31. 6.40T	39. 7.00R	47. 7.12R	55. 7.24R	63. 7.36R	
8. 6.70R	16. 6.775R	24. 6.88R	32. 6.46T	40. 7.63T	48. 7.75T	56. 7.87T	64. 7.99T	
							65. 7.39R	

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(iii) Stations in the Disaster Communications Service;

(iv) Stations of the United States Government authorized by the responsible agency to exchange communications with RACES stations;

(v) Any other station in any other service regulated by the Federal Communications Commission, whenever such station is authorized by the Commission to exchange communications with stations in the Radio Amateur Civil Emergency Service.

§97.191 Permissible communications.

All communications in the Radio Amateur Civil Emergency Service must be specifically authorized by the civil defense organization for the area served. Stations in this service may transmit only civil defense communications of the following types:

(a) Communications concerning impending or actual conditions jeopardizing the public safety, or affecting the national defense or security during periods of local, regional, or national civil emergencies:

(1) Communications directly concerning the immediate safety of life or individuals, the immediate protection of property, maintenance of law and order, alleviation of human suffering and need, and the combating of armed attack or sabotage;

(2) Communications directly concerning the accumulation and dissemination of public information or instructions to the civilian population essential to the activities of the civil defense organization or other authorized governmental or relief agencies.

(b) Communications for training drills and tests necessary to ensure the establishment and maintenance of orderly and efficient operation of the Radio Amateur Civil Emergency Service as ordered by the responsible civil defense organization served. Such tests and drills may not exceed a total time of one hour per week.

(c) Brief one way transmissions for the testing and adjustment of equipment.

§97.193 Limitations on the use of RACES stations.

(a) No station in the Radio Amateur Civil Emergency Service shall be used to transmit or to receive messages for hire, nor for communications for material compensation, direct or indirect, paid or promised.

(b) All messages which are transmitted in connection with drills or tests shall be clearly identified as such by use of the words "drill" or "test", as appropriate, in the body of the messages.

DuPage FM

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Portable Specials for June
TWO METER PORTABLES

RCA TACTECS

The TACTEC is the latest model portable made by RCA and features extensive use of ICs and separate transmitter and receiver boards for easier servicing.

Conversion to the two meter amateur band requires ordinary alignment procedures. COMPONENTS NEED NOT BE CHANGED FOR AMATEUR USE. An external speaker-mike can be added without modifying the radio.

TACTECs are made in two basic models: Standard housing which accommodates up to two frequencies plus dual squelch, and Options housing which can accommodate up to six frequencies plus dual squelch.

These radios have recently been removed from commercial service.

A **New Nicad Battery** is included with each TACTEC radio.

Frequency range: 150 to 162 mc
Receiver sensitivity: .25 microvolt for 12 dB SINAD
Power output: 2 watts minimum (5 watts available as option)
Size with battery: 2.6" x 1.6" x 6"
Weight with battery: 18 ounces

Standard Housing TACTEC
TACTEC portable w/std. squelch $375.00
TACTEC portable w/dual squelch $400.00
Options Housing
TACTEC portable w/std. squelch $400.00
TACTEC Portable w/dual squelch $425.00
Desk top battery charger $45.00

Like new . . .

450 MC PORTABLES – RCA Personalfone 450

These portables are similar to the Motorola HT-200 in size and weight, but use modular construction techniques. Conversion to the amateur band requires crystals and ordinary alignment techniques.

Frequency range: 450 to 470 mc
Power output: 1 watt
Receiver sensitivity: .7 microvolt EIA SINAD
Weight with battery: 40 ounces
Size: 3.2" x 1.8" x 8.8"
Personalfone 450 with standard squelch $225.00
Personalfone 450 with dual squelch $250.00
Battery charger $40.00

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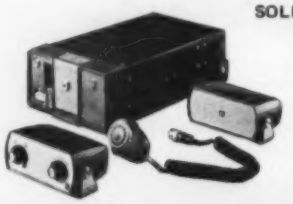

We were able to acquire a limited quantity of RCA SuperFleetfones. These radios are all transistorized and are rated for 50 watts output continuous duty. There are no relays or other moving parts.

These units are in the 42 to 50 mc band segment and are ideal for use in the six meter ham band. With modifications they can be used in other segments of the 25 to 50 mc band.

Model CMFB-50 with accessories (for June only) **$200.00** Regularly $325.00.

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CONCURRING STATEMENT OF COMMISSIONER CHARLOTTE T. REID (CHAIRMAN RICHARD E. WILEY AND COMMISSIONER BENJAMIN L. HOOKS JOIN) RE: RACES

I have concurred with my colleagues in this decision because I believe RACES remains a viable means of communications. RACES can and has filled a communications void in times of emergencies and I feel it should be administered and operated primarily by licensed amateurs. However, I do feel there will be bona fide emergencies where licensed amateurs may not be available and, in such cases, commercial operators should be allowed to operate the RACES stations until the licensed amateurs arrive on the scene. I would have preferred an exception to the licensed amateur operator rule with a restriction that such use could be only in time of an extreme emergency, not routine police, fire or ambulance activity.

PUBLIC NOTICE WAIVER TO PERMIT AMATEUR TV REPEATERS

March 1, 1976-S

The Commission, by Chief, Safety and Special Radio Services Bureau, has waived Section 97.61(c) of the Commission's Rules for a period of 1 year to permit operation of fast-scan amateur television repeater stations outside of the sub-bands normally reserved for repeater operations in the 450 MHz amateur band.

On January 25, 1974, the Commission issued a six month Special Temporary Authorization which waived Section 97.61(c) of the Rules governing the Amateur Radio Service to permit operation of fast-scan television repeater station WR4AAG in the 450 MHz band. The station is used to retransmit television signals of other amateur television stations throughout the Washington, D.C., area, for the purpose of gathering experimental data concerning the feasibility of fast-scan television repeater operations at 450 MHz. The Special Temporary Authority waiving Section 97.61(c) was renewed several times subsequent to its issuance, with the most recent renewal set to expire on March 3, 1976. A petition for rulemaking to allow regular operation of this station, RM-2507, was filed on January 16, 1975. The Commission now has that petition under consideration, as well as several other requests of a similar nature. Pending formal consideration of these petitions, and pending implementation of a formal frequency coordinating mechanism within the Amateur Radio Service which would oversee the frequency selections of all repeater stations, the Commission is waiving Rule Section 97.61(c) for a period of 1 year to permit continued experimentation in this mode of operation. Any licensed amateur repeater station operating in the 450 MHz band may conduct such tests without prior Commission approval. This waiver is effective February 27, 1976. Authority for this waiver is contained in Section 0.331 of the Commission's Rules.

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2 Slide Switches for alarm set and enable
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1 IN914 Diode
1 .01 Disc Cap
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Units tested for 500NS Speed.

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CD4011	.25	CD4049	.75	74C76N	3.00
CD4012	.25	CD4050	.79	74C85N	2.00
CD4013	.47	CD4051	2.85	74C107N	1.25
CD4016	.56	CD4052	2.85	74C151	2.90
CD4017	1.35	CD4053	2.85	74C154	3.60
CD4019	.55	CD4060	3.25	74C157	2.15
CD4020	1.49	CD4066	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4072*	.45	74C164	3.25
CD4025	.25	CD4081	.45	74C173	2.60
CD4027	.69	CD4511	2.50	74C193	2.75
CD4028	1.65	CD4518	2.50	74C195	2.75
CD4029	2.90	74C00N	.39	MC4044*	4.50
CD4030	.65	74C02N	.55	MC14016*	.56

LINEAR

LM300H	.80			LM1351N	1.65
LM301H	.35	LM377N	4.00	LM1414N	1.75
LM301CN	.39	LM380N	1.39	LM1458C	.65
LM302H	.75	LM1496N	.95	LM1488N	.95
LM304H	1.00	LM380CN	1.05	LM1558V	1.85
LM305H	.95	LM381N	1.79	LM2111N	1.95
LM307CN	.35	LM382N	1.79	LM2901N	2.95
LM309H	1.00	NE501K	8.00	LM3065N	.69
LM309CN	1.00	NE510A	6.00	LM3900N	.55
LM309H	1.10	NE531H	3.00	LM3905N	.60
LM309K	1.25	NE536T	6.00	LM3909*	1.25
LM310CN	1.15	NE540L	6.00	LM5556N	1.65
LM311H	.90	NE550N	.79	MC5558V	1.65
LM311N	.90	NE553	2.50	LM7525N	.90
LM318CN	1.50	NE555V*	.45	LM7535N	1.25
LM319N	1.30	NE560B*	5.00	8038T*	4.95
LM319D	9.00	NE561B*	5.00	LM75450	.49
LM320K-5	1.35	NE562B*	5.00	75451CN	.39
LM320K-5.2	1.35	NE565H*	.99	75452CN	.39
LM320K-12	1.35	NE565N*	1.25	75453CN	.39
LM320K-15	1.35	NE566CN*	1.95	75454CN	.39
LM320T-5*	1.75	NE567H*	1.25	75491CN	.79
LM320T-8*	1.75	NE567V*	1.50	75492CN	.89
LM320T-12*	1.75	LM703CN	.45	75494CN	.89
LM320T-18*	1.75	LM709H	.29	**RCA LINEAR**	
LM323K-5*	9.95	LM709N	.29	CA3013	1.70
LM324N	1.80	LM710N	.79	CA3023	2.15
LM339N	1.70	LM711N	.39	CA3035	2.25
LM340K-5	1.95	LM723N	.55	CA3039	1.35
LM340K-12	1.95	LM723H	.55	CA3046	1.15
LM340K-15	1.95	LM733N	1.00	CA3059	2.46
LM340K-24	1.95	LM739N	1.79	CA3060	2.60
LM340T-5	1.75	LM741CH	.35	CA3080	.85
LM340T-6	1.75	LM741CN	.35	CA3081	1.75
LM340T-8*	1.75	LM741 14N	.39	CA3082	2.00
LM340T-18*	1.75	LM747N	.79	CA3083	1.60
LM340T-12	1.75	LM747N	.79	CA3086	.59
LM340T-15	1.75	LM748H	.39	CA3089	3.25
LM340T-24	1.75	LM748N	.39	CA3091	8.25
LM350N	1.00	LM1303N	.90	CA3123	1.85
LM351CN	.65	LM1304N	1.19	CA3130*	1.49
LM370N	1.15	LM1305N	1.40	CA3600	1.75
LM370H	1.15	LM1307N	.85	RC4194	5.95
LM373N	3.25	LM1310N	2.95	RC4195	3.25

KITS EXAR ICS

XR-2206KA — **SPECIAL $17.95**
Includes monolithic function generator IC, PC board, and assembly instruction manual.

XR-2206KB — **SPECIAL $27.95**
Same as XR 2206KA above and includes external components for PC board.

TIMERS		**STEREO DECODERS**	
XR-555CP	$.69	XR-1310P	$3.20
XR-320P	1.55	XR-1310EP	3.20
XR-556CP	1.85	XR1800P	3.20
XR-2556CP	3.20	**WAVEFORM GENERATORS**	
XR-2240CP	3.25	XR-205	8.40
PHASE LOCKED LOOPS		XR-2206CP	4.49
XR-210	5.20	XR-2207CP	3.85
XR-215	6.60	**MISCELLANEOUS**	
XR-567CP	1.85	XR-2211CP	6.70
XR-2567CP	2.99	XR-2261	3.79
		XR4136	2.00

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	**$2.95**
CMOS	Pin-out & Description of 4000 Series ICS	**$2.95**
LINEAR	Pin-out & Functional Description	**$2.95**
	ALL THREE HANDBOOKS $6.95	

CONSUMER ELECTRONICS

exelar

DIGITAL WATCH
This watch is manufactured by National Semiconductor. It provides 5 functions; hours, minutes, seconds, date, A.M. indicator dot. Accuracy is assured to 5 seconds per month by precision quartz crystal. If something should go wrong with the watch, repair is assured within 48 hours after it is received. Complete with steel black leather band.

ES4-YS
3 MICRON GOLD PLATE BEZEL
$29.95
NOT A KIT

Novus

DIGITAL ALARM CLOCK
This 4 digit Novus Alarm Clock is a very reliable and smartly styled unit. It provides such features as an alarm settable to any minute of the day, a 7 minutes snooze alarm, a power failure indicator, and even an A.M., P.M. indicator.

NOT A KIT **$19.95**

OPTO ELECTRONICS

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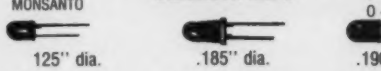
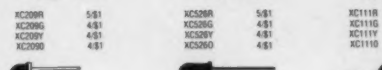
DISCRETE LEDS

R - RED
G - GREEN
Y - YELLOW
O - ORANGE

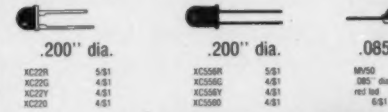


125" dia.		.185" dia.		.190" dia.	
XC209R	5/$1	XC526R	5/$1	XC111R	5/$1
XC209G	4/$1	XC526G	4/$1	XC111G	4/$1
XC209Y	4/$1	XC526Y	4/$1	XC111Y	4/$1
XC209O	4/$1	XC526O	4/$1	XC111O	4/$1



.200" dia.		.200" dia.		.085" dia.	
XC22R	5/$1	XC556R	5/$1	MV50	
XC22G	4/$1	XC556G	4/$1	.085" dia. Micro red led	6/$1
XC22Y	4/$1	XC556Y	4/$1		
XC22O	4/$1	XC556O	4/$1		

DISPLAY LEDS



TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	COMMON ANODE	270	$3.25	MAN 74	COMMON CATHODE	300	$1.50
MAN 2	5 x 7 DOT MATRIX	300	4.95	DL707	COMMON ANODE	300	$1.50
MAN 3	COMMON CATHODE	125	.39	DL747	COMMON ANODE	600	2.25
MAN 4	COMMON CATHODE	.187	1.95	DL750	COMMON CATHODE	600	2.49
MAN 7	COMMON ANODE	300	1.50	DL33B	COMMON CATHODE	110	1.25
MAN 7G	COMMON ANODE-GREEN	300	2.50	FND70	COMMON CATHODE	250	.50
MAN 7Y	CUMMON ANODE-YELLOW	300	2.50	FND500	COMMON CATHODE	500	1.75
MAN 72	COMMON ANODE	300	1.50	FND507	COMMON CATHODE	500	1.75

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin	$.17	16	15
14 pin	20	19	18
16 pin	22	21	20
18 pin	29	28	27
22 pin	37	36	35
24 pin	$.38	.37	.36
28 pin	.45	.44	.43
36 pin	.60	.58	.58
40 pin	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin	$.27	25	24
16 pin	30	27	25
18 pin	35	32	30
24 pin	.48	45	42
28 pin	$ .99	.90	.81
36 pin	1.39	1.26	1.15
40 pin	1.59	1.45	1.30

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100
8 pin	$.30	.27	.24
14 pin	35	32	29
16 pin	38	35	32
24 pin	$ .70	.63	.57
28 pin	1.10	1.00	.90
36 pin	1.75	1.40	1.26
40 pin	1.75	1.58	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
10 pin	$.45	.41	.37
14 pin	.39	.36	.37
16 pin	.43	.42	.41
18 pin	.75	.68	.62
24 pin	$1.05	.95	.85
28 pin	1.40	1.25	1.10
36 pin	1.58	1.45	1.30
40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	
ASST. 1	9 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% - 50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% - 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K	
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% - 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K	
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5% - 50 PCS.
		22K	27K	33K	39K	47K	
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5% - 50 PCS.
		150K	180K	220K	270K	330K	
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5% - 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M	
ASST. 7	9 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% - 50 PCS.

ALL OTHER RESISTORS FROM 2.2 OHMS - 5.6M AVAILABLE IN MULTIPLES OF 5 ea.
1-25 PCS. .05 ea. 26-99 PCS. .04 ea. 100-499 PCS. .03 ea. 500-999 .027 ea.

14 PCS. POTENTIOMETER ASSORTMENTS

ASST. A 2 ea. 10 OHM-20 OHM-50 OHM-100 OHM-200 OHM-250 OHM-500 OHM
ASST. B 2 ea. 1K, 2K, 2.5K, 10K, 20K, 25K, 50K
ASST. C 2 ea. 50K, 100K, 200K, 250K, 500K, 1M, 2M

$9.95 Per Asst.

Each assortment contains 14 pcs of 10 turn pots. All pots are available in single unit quantities. **$.99 ea.**

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74LS00 TTL

74LS00	.39	74LS55	.39	74LS151	1.55
74LS02	.39	74LS73	.65	74LS153	1.89
74LS03	.39	74LS74	.65	74LS157	1.55
74LS04	.45	74LS75	.79	74LS162	2.25
74LS05	.45	74LS76	.65	74LS163	2.25
74LS08	.39	74LS83	2.19	74LS164	2.25
74LS10	.39	74LS86	.65	74LS181	3.69
74LS13	.79	74LS90	1.25	74LS190	2.85
74LS14	2.19	74LS92	1.25	74LS191	2.85
74LS20	.39	74LS93	1.25	74LS192	2.85
74LS26	.49	74LS95	2.19	74LS193	2.85
74LS27	.45	74LS96	1.89	74LS194	2.25
74LS28	.49	74LS107	.65	74LS195	2.25
74LS30	.39	74LS112	.65	74LS257	1.89
74LS32	.45	74LS132	1.55	74LS260	.55
74LS40	.49	74LS136	.65	74LS279	.79
74LS51	.39	74LS138	1.89	74LS670	5.95

DIP SWITCH
These switches feature four SPST Rocker switches in a molded dip. They are ideally suited for microprocessor applications. **$1.95**

SPDT			.INT	1	2-9	10-99	100-up
ON	OFF	ON	221	3.95	2.95	1.97	1.39
ON	NONE	ON	203	3.95	2.95	1.69	1.51
ON	OFF	ON	121	2.35	1.95	1.42	1.30
ON	NONE	ON	123	2.65	1.85	1.21	1.10

MINATURE TOGGLE

SPDT — SERIES PB, PBT

	Model Number	1 Each	Quantity per prices 2-9	10-99	100-up
Momentary Action Switch: Push To Make Contact - And Push To Break Contact	PB-123	$2.15	$1.95	$1.47	$1.30
Momentary Action Switch: Normally Open or Normally Closed (Per N.C circuit use terminals 2 & 1, for N.O. 2 & 3, for N.C and N.O. 1,2,&3	PB-126	$2.35	$1.95	$1.47	$1.30

5 AMP RATINGS

PUSH BUTTON

THUMBWHEEL SWITCHES

ACCESSORIES		
Part No.	Description	Price
SF EP	End Plate (Pair)	$.50
SF DP	Divider Plate (each)	40
SF BB	Blank Body (each)	40
SF HB	Half Body (each)	40

ACCESSORIES		
Part No.	Description	Price
SF EP	End Plates (pair)	$.50
SF DP	Divider Plate (each)	40
SF BB	Blank Body (each)	40
SF HB	Half Body (each)	40

8 POSITION ROTARY SWITCH — $.79

These switches are a 7 position one position open, rotary switch enclosed in a TO-5 can. They have a standard 6 pin configuration and will mount perfectly on printed circuit board.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4005*	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
IN755	6.2	400m	4/1.00	IN3600	50 PIV	200m	6/1.00
IN7*4	6.8	400m	4/1.00	IN4148	75	10m	15/1.00
IN965B	15	400m	4/1.00	IN4154	35	10m	12/1.00
IN5232	5.6	500m	2/$	IN4734	5.6	1w	2/$
IN5234	6.2	500m	2/$	IN4735	6.2	1w	2/$
IN5235	6.8	500m	2/$	IN4736	6.8	1w	2/$
IN5236	7.5	500m	2/$	IN4738	8.2	1w	2/$
IN455	25	40m	6/1.00	IN4742	12	1w	2/$
IN458	150	7m	6/1.00	IN4744	15	1w	2/$
IN485A	180	10m	5/1.00	IN1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	IN1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	IN1186	200 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	IN1188	400 PIV	35 AMP	3.00
1N4004	400 PIV	1 AMP	12/1.00				

TRANSISTORS

MPS A05	5/$1.00	PN2907	3/$1.00	PN4249	4/$1.00
MPS A06	5/$1.00	PN2907A	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN2946	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	PN3569	4/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	PN3638	4/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3702	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3703	5/$1.00	2N4409	4/$1.00
PN2415	5/$1.00	2N3705	5/$1.00	2N5089	4/$1.00
2N2484	4/$1.00	2N3707	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N3711	5/$1.00	2N5088	4/$1.00
2N2907A	5/$1.00	2N3724	$ .65	2N5089	4/$1.00
2N2925	5/$1.00	2N3725	$1.00	2N5129	4/$1.00
2N3053	2/$1.00	2N3903	5/$1.00	2N5138	5/$1.00
2N3055	$ .89	2N3904	4/$1.00	2N5139	5/$1.00
MJE3055	$1.00	2N3905	4/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N3906	4/$1.00	2N5951	5/$1.00
2N3392	5/$1.00	2N4013	3/$1.00	C106B1/SCR	2/$1.00
2N3393	5/$1.00	2N4124	3/$1.00	2N5452	$2.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100	1-9	10-49	50-100
10 pf	05	04	03	.001µF	04	035
22 pf	05	04	03	.0047µF	05	04	035
47 pf	05	04	03	.01µF	05	04	035
100 pf	05	04	03	.022µF	06	05	04
220 pf	05	04	03	.047µF	06	05	04
470 pf	05	04	035	1µF	12	09	075

100 VOLT MYLAR FILM CAPACITORS

.001mf	12	10	07	.022mf	13	11	08
.0022	12	10	07	.047mf	21	17	13
.0047mf	12	10	07	1mf	37	33	17
.01mf	12	10	07	33mf	33	27	22

20% DIPPED TANTALUMS (SOLID) ELECTROLYTIC CAPACITORS

1 35V	.28	.23	.17	1.5 35V	.30	.26	.21
15 35V	.28	.23	.17	2.2 25V	.31	.27	.22
22 35V	.28	.23	.17	3.3 25V	.31	.27	.22
33 35V	.28	.23	.17	4.7 25V	.32	.28	.23
47 35V	.28	.23	.17	6.8 25V	.36	.31	.25
68 35V	.28	.23	.17	10 25V	.40	.35	.29
1.0 35V	.28	.23	.17	15 25V	.53	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

	Axial Lead			Radial Lead		
47 50V	15	13	10	47 25V	15	13	10
1.0 50V	16	14	11	47 50V	16	14	11
3.3 50V	17	15	12	1.0 50V	16	14	12
4.7 25V	16	14	10	1.0 25V	16	14	11
10 25V	16	13	10	1.0 50V	16	14	11
10 50V	16	14	12	4.7 16V	15	13	10
22 25V	17	15	12	4.7 25V	15	13	10
22 50V	24	20	18	4.7 50V	16	14	11
47 25V	19	17	15	10 16V	14	12	10
47 50V	25	21	19	10 25V	15	13	10
100 25V	24	20	18	10 50V	16	14	12
100 50V	35	30	26	47 50V	24	21	19
220 25V	32	28	25	100 16V	19	15	14
220 50V	45	41	38	100 25V	24	20	18
470 25V	33	29	27	100 50V	35	30	26
1000 16V	55	50	45	220 16V	23	17	16
2200 16V	70	62	55	470 25V	31	26	26

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HEY! This is like two transceivers in one! Fully synthesized covering 143.5 to 148.5 MHz in 5 kHz increments. Standard 600 kHz offsets up or down automatically. Reverse simplex and frequency split allow totally independent receive and xmit frequencies, and a priority channel guard that switches you back to it as soon as a signal is detected.

- *Sensitivity – .35uV for 12 dB sinad, .30uV for 20 dB quieting*
- *20 Watts output*
- *Intermodulation, spurious and image 60 dB minimum*
- *10 pole xtal filter*
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- *S-meter speaker built-in*
- *Independent selectable priority channel*

$599.00

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6 Digit LED Clock Kit - 12/24 hr.

$9.50 ea. IN QUANTITIES OF 1 TO 5

$8.50 ea. IN QUANTITIES OF 6 OR MORE

KIT INCLUDES
- INSTRUCTIONS
- QUALITY COMPONENTS
- MONEY BACK GUARANTEE
- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

6 – LED Readouts (FND-70 .25 in. Red, com. cathode)
1 – MM5314 Clock Chip (24 pin)
13 – Transistors
3 – Switches
3 – Capacitors
5 – Diodes
9 – Resistors
24 – Molex pins for IC socket

ORDER KIT #850
AN INCREDIBLE VALUE!

"Kit #850 will furnish a complete set of clock components as listed. The only additional items required are a 7-11 VAC transformer, a circuit board and a cabinet, if desired."

Printed Circuit Board for kit #850 or #850-4 (etched & drilled fiberglass) $2.95
Standard Transformer 115 VAC/8 VAC. 1.50
Molded Plug Transformer 115 VAC/10 VAC (with cord) 2.50
Plexiglas Cabinet II red chassis, white case (see below) 5.95

KIT #850-4 same as #850 except larger .4" LEDs 12.50

60 Hz Xtal Timebase Kit
Power: 5-16VDC/2.5 mA @ 12 VDC.
Size: PC board approx 1"x1¾".
Accuracy: ±2 ppm (adjustable)

Will free IC digital clock from ac timebase and allow 12 VDC operation. Use in car, van, boat, camper, etc. 6/28.95, 5.95 each.
(4.95 when purchased with any clock kit.)

This is a complete – single IC kit with info for easy hookup to most IC clocks.

Jumbo Digit Conversion Kit – for LED clocks. Kit provides a multiplex display board and six .5" LED digits (FND-503 or FND-507) LEDs require only 5 mA/seg and can be driven by most any LED clock circuit. Data for displays and hookup included. (Connections from this board will line up point to point with kit #850 PC board) Specify common anode or cathode displays $9.95

Jumbo Digit Clock Kit Complete – Kit features six .5" red digits. All components, PC boards, plug transformer, line cord, etc. Uses mm5314 IC, 50/60 Hz op., 12 or 24 hr. (will fit cab. I) Kit #5314-5 complete less case $19.95

6 Digit LED Clock-Calendar-Alarm Kit

• 12/24 HR TIME • JUMBO DIGITS (MAN-64) • 28-30-31 DAY CALENDAR • AC FAILURE/BATTERY BACK-UP • 24 HR ALARM – 10 MIN. SNOOZE • ALTERNATES TIME (8 SEC) AND DATE (2 SEC) OR DISPLAYS TIME ONLY AND DATE ON DEMAND • THIS KIT USES THE FANTASTIC CT-7001 CHIP. FOR THE PERSON THAT WANTS A SUPER CLOCK KIT (TOO MANY FEATURES TO LIST)!

50/60 Hz OP

COMPLETE KIT, including Power Supply, Line Cord, Drilled PC Boards, etc.

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6¼" WIDE
5½" DEEP

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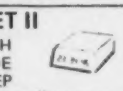

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FND-510	RED	.5"	1.55
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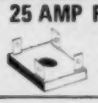

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2N3704	NPN	TO-92
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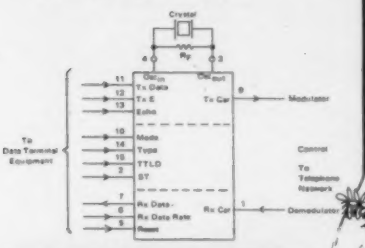

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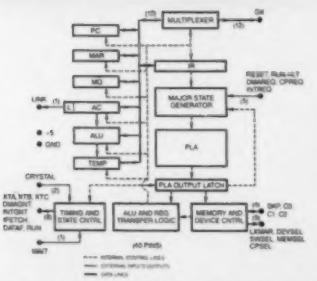

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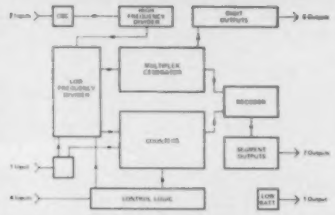

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22 uH.....10/$1.00
24 uH.....10/$1.00
27 uH.....10/$1.00
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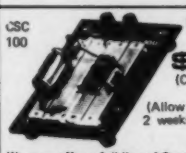

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7448	.89
7453	.16
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7474	.37
7475	.65
7476	.39
7483	.85
7490	.69
7492	.75
7493	.75
7495	.75
7496	.75
74121	.38
74123	.75
74151	.75
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74163	1.19
74164	1.89
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CD4034	3.25
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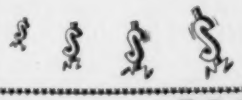

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Cat.No. 6A 2610 Untested.
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Cat.No. 6A2628 Untested.

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POWER TRANSISTORS
40 for $1.98
15 watt Beside B-5600 pellet translators, all good, purchased from a re-tester, have millions of 'em
100 % good Cat.No. 6A 2737

BARREL KIT #60
DTL'S IC'S
75 for $1.98
Untested.
This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. Cat.No. 6A 2726

BARREL KIT #61
POLYSTYRENE CAPS
100 % good
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 6A2729

BARREL KIT #65
MIXED READOUTS
15 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate.
Cat.No. 6A 2733 Untested.

BARREL KIT #68
2 WATTERS
100 for $1.98
100 % good.
Nobody seems to want 'em! So many suppliers don't count, but throw 'em in the barrel. It's a ll'l gold mine All marked. Cat.No. 6A 2735

BARREL KIT #71
CAPACITOR SPECIALS
100 pcs. $1.98
Emptied stockrooms into barrels of mylars, poly's, micas, molded, plastics, ceramics, discs, etc. Nifty 100 % good Cat.No. 6A 2738

BARREL KIT #73
TRANSISTOR ELECTROS
50 for $1.98
It bugs" us why the factories dump 'em in barrels. We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 6A 2747

BARREL KIT #74
PC BOARD ZENERS
400mW ZENERS
150 for $1.98
Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V type. Hermetically sealed glass pak. Double plug.
Cat.No. 6A 2740

BARREL KIT #76
1-WATT ZENERS
100 for $1.98
Untested.
Factory same as 400-mw's, Never-to-see-again offer. 6, 8, 10, 12, 15V, under glass. Double plug.
Cat.No. 6A 2741

BARREL KIT #77
"BROWN" BODY TRANSISTORS
40 for $1.98
G-E D-40 series: hi-voltage, Darlingtons, hi-current, spn's. Factory line discontinued. Power tabs.
Cat.No. 6A 2742 Untested.

BARREL KIT #78
"RED" BODY TRANSISTORS
40 for $1.98
D-42 series. You test—go nuts your own biz! High current, hi-V, NPN.
Cat.No. 6A 2743 Untested

BARREL KIT #81
SUBMINI RESISTORS
200 for $1.98
100 % good.
PC, upright type, color coded, ¼ watt. Asst values. Come to us in a barrel.
Cat.No. 6A 2746

BARREL KIT #83
15 for $1.98
LM-340T VOLTAGE REGULATORS
Untested
Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat.No. 6A 2635

BARREL KIT #87
NATIONAL IC BONANZA
100 for $1.98
Factory dumps into barrels. Types 5000, 7400 series, DTL, ROMs, registers, clock & calc., chips, linears, etc.
Cat.No. 6A 2660 Untested.

BARREL KIT #91
SILVER MICAS
100 for $1.98
Cat.No.6A 3018
For the first time silver micas on buy in price! Axial, red case, variety of physical sizes & values. Greatest barrel distributor prices. Wt. 1 lb.

BARREL KIT #94
"BUBBLE" READOUTS
12 for $1.98
DL-33B bubble magnifiers. Segs missing. Truthfully so many of 'em we don't care. Untested. 3 oz.No.6A.3046

BARREL KIT #95
PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100 % good. Cat.No. 6A 3052

BARREL KIT #102
CLOCK CHIPS
5 for $1.98
No. 6A 3058
National is dumping! MM-5316 — what's wrong with 'em, we don't know, but we got barrels. Hobby special. Wt. 2 oz.

BARREL KIT #104
SLIDE VOLUME CONTROLS
10 for $1.98
Cat.No. 6A 3057
Used in hi-fi, volume control maker unloads. Asst. values, what a buy. Worth $1 ea. We've got barrels of 100 % material.

BARREL KIT #107
SQUARE OHMS
60 for $1.98
Cat.No. 6A 3096
Factory people were sometimes "squares" when they topple prime square ohms mix 'em up in barrels. Asst. values, watts. Wt. 1 lb.

BARREL KIT #108
TO-5 PLASTIC TRANSISTORS
Cat.No. 6A3101
40 for $1.98
Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested, but guaranteed to a 60 % yield.

BARREL KIT #109
TERMINAL STRIPS
150 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat.No. 6A 3139

BARREL KIT #110
SUPPRESSOR DIODES
50 for $1.98
Cat.No.6A3137
Keeps ignition noises out! Axial. Untested, but the of your oops!., car, industrial, etc. Double plug.

BARREL KIT #111
MULTI DIGIT READOUTS
8 for $1.98
barrels of blemished 3, 4 and/or 5 digit readouts to USA for "dump". Untested.
Cat.No. 6A3138

BARREL KIT #112
MICRO MINI LEDS
40 for $1.98
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50 % or better.
Cat.No. 6A 3139

BARREL KIT #113
STABISTORS
50 for $1.98
Cat.No. 6A3140
Regulator, sensing and computer circuitry. Axial double plug type. Discontinued factory line, PIV 20 volts, 80 % yield. U test 'n save!

BARREL KIT #115
MOLEX SOCKETS
300 for $1.98
100 % good.
Calculator maker dump! We got a zillion of 'em. Used for IC sockets, etc.
Cat.No.6A 3144

BARREL KIT #116
BUTTONS 'N FEEDTHRU'S
100 for $1.98
100 % good.
Truthfully worth a small fortune. Wide asst. of button-feedthru caps! HAMS TAKE NOTE! RF, UHF, etc. Wt. 1 lb. Cat.No 6A3141

BARREL KIT #117
20-MIL OPTICAL FIBERS
200-FT. $1.98
Fiber optics factory bankruptcy purchase! High quality, most-commonly used size (20-mil). CLEAR. Lowest price. 6A3206

BARREL KIT #118
MINI SCRS
50 for $1.98
UNBELIEVABLE! TO-92 plastic SCRS in barrels . . . rite from factory. Includes all voltages up thru 206 prv. 6A 3138

BARREL KIT #119
MODULAR SWITCHES
25 for $1.98
Centralab "push-ON" switches. TV-makers ex. ceess. Dpdt, 6pdt, etc. Brand new. Cat. No. 6A3150

BARREL KIT #120
TRIGGER DIODES
25 for $1.98
Type ER-900, same type used to trigger scrs, triacs. Sometimes called "diacs". Untested. No. 6A 3160

BARREL KIT #121
"MINI" MAGNETS
100 for $1.98
Magnet circular and rectangular cuttings from a major maker — For reed switches & micro-circuitry.
Cat. No. 6A 3168

BARREL KIT #122
PLASTIC OPTICAL FIBERS
500-Ft. $1.98
Pop'lr 10-mil size. Excellent for making lite pipes, experiments, lamp sprays.
Cat. No. 6A 3159

BARREL KIT #123
CD-4002 C-MOS IC
15 for $1.98
mostly good. But we have 250,000. Can never sell 'em out. YOUR GAIN! Their number is CD-5602.
Cat. No. 6A 3217

BARREL KIT #126
UPRIGHT ELECTROS
40 for $1.98
Wide asst. of values from 1mf to 300mf in mixture of voltages. 100 % marked good. Why barreled? U-got-a-buy!
Cat. No. 6A 3226

BARREL KIT #127
AXIAL ELECTROS
40 for $1.98
Truthfully the factories (by mixing 'em in barrels) do all of us a favor. WUT A BUY! Asst. capacities and voltages.
Cat. No. 6A 3227

BARREL KIT #128
MINI DIP ICS
75 for $1.98
Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 703, 567, 555, 558—but who knows? Factory to you. All mixed, you test. Wt. 1 lb.
Cat. No. 6A 3245

BARREL KIT #131
TANTALUM ELECTROS
30 for $1.98
Mixed, marked prime, top grade asst. values, voltages. GE, Centralab, etc.
Cat. No. 6A 3255

BARREL KIT #133
C-MOS IC'S
60 for $1.98
Deliberately thrown in barrels, so we can't test 'em! The famous CD400 series. How good? Who knows? Who cares? It's only 3c ea.
Cat. No. 6A 3257

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HAWAII	14	14	14	7B	7	7	7	7	7A	14	14	14
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A = Next higher frequency also may be useful
B = Difficult circuit this period
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U = Unsettled
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		1 U	2 D	3 U	4 D	5 U
6 U	7 N	8 N	9 N	10 U	11 U	12 U
13 U	14 N	15 N	16 N	17 N	18 D/DX	19 U/DX
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495.00

the amplifier . . .

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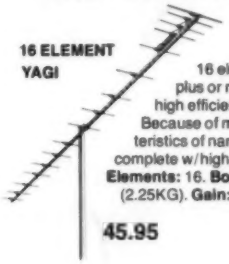
the applications . . .

OSCAR uplink with SSB and CW . . . (using **transmitter** only) . . .

Transceiver for point-to-point communications . . . Hill topping . . . Summer VHF tests (boost your score through OSCAR). A great, compact, lightweight portable. A fine base station with auxiliary AC supply.

the antenna . . .

16 ELEMENT YAGI



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